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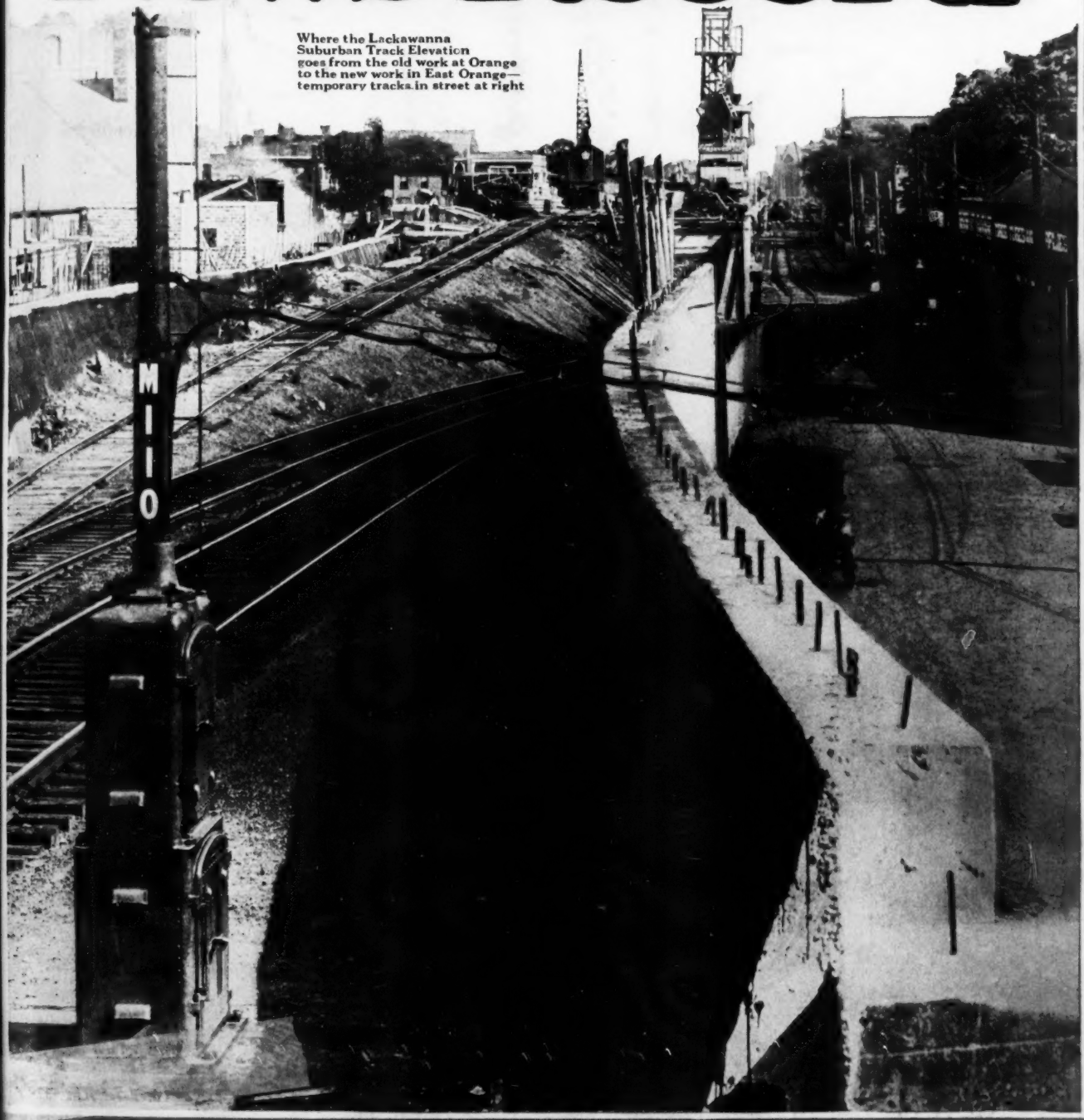
November 9, 1922

Engineering News-Record



Where the Lackawanna Suburban Track Elevation goes from the old work at Orange to the new work in East Orange—temporary tracks in street at right

In this issue: **D., L. & W. R. R. Grade Elevation Through the Oranges—Repairing the Spillway of the Gibraltar Dam in California—The New Stadium for the University of Kansas—Making Precast Concrete Blocks for Milwaukee's Activated Sludge Plant—*From Job and Office: Hints That Cut Costs and Time***

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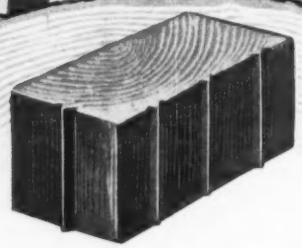

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 89 — NEW YORK, NOVEMBER 9, 1922 — Number 19

A Rapid Transit Railroad

RAILROADS entering our biggest cities are more and more taking on, so far as their passenger service is concerned, the characteristics of the urban rapid transit lines. Around New York notably, but with increasing degree at Chicago, Philadelphia, and Boston, the suburban railroad is becoming a rapid transit railroad; that is, it runs on a separate level from the street, has closely spaced stations with express and local services, and is or should be operated by electricity. So far the Lackawanna's New Jersey division, described on another page of this issue, has not been electrified, but with that exception it is a model of modern suburban railway development. Slowly, because of the war, the opposition of some of the cities through which it passes and the difficulties of construction in a narrow right-of-way carrying a train a minute several hours each day, the road has gone ahead with this regrade until now there is in sight an express and local line without a grade crossing through 35 miles of its length. The structures, some of them of unique design, are permanent and artistic, the stations are convenient and pleasing to view, the traffic has been maintained at fair effectiveness under conditions of congestion almost insurmountable, all of which testifies to high quality of engineering, and the whole improvement shows to what expense a railroad can go to get and to hold a purely passenger traffic which pays a low rate per ride, but which is continual and of uniform distribution through the year.

Are Highways "Located"?

IN A letter published elsewhere in this issue R. S. Blinn raises two questions: Is railroad locating a lost art? Does highway engineering suffer from the lack of engineers trained in railroad location? Mr. Blinn answers both of these in the affirmative; the first with a qualifying "in the main," and the second without qualification. Unquestionably the meager railroad construction of recent years has offered small opportunity in this country to raise up new locating engineers in the place of those who have passed on. But doubtless there are some; and it would be interesting to learn how many of them, like Mr. Blinn, are now in highway work. If location training is so important in highway practice as he asserts, these men should be in a fair way to keep their hands in and thereby preserve the art. But here arises the second question, to which it would be worth while to have an answer from the highway engineer. Just how great is the need in highway engineering for locating skill? What share of our highways can be located as a railroad would be, and what share must stick closely to existing roads? To what extent is the location, even of new highways, controlled by conditions outside the domain of engineering science? And even though there may be room for a science or an art of highway location, to what extent would this agree with railroad practice, and to what extent must wholly new or modified principles be developed? Everyone knows that in highway *construction* many lessons are to be learned from railroad practice. Cross-sections, drainage and earthwork all involve similar principles and to some extent similar practice in both; but the question now before the house concerns *location*. What can the "old-time locaters" and the "newly-born highway engineers" contribute on that score?

Motor Killings and the Engineer

IN the year 1921, the Bureau of the Census announces, 10,168 deaths from accidents caused by four-wheeled motor vehicles occurred within the registration area of the United States, which contains about 82 per cent of the population. This is a death rate of 11.5 per 100,000, an increase of 28 per cent over 1917. Further than that, the increase in rate is itself increasing from year to year, and the rate in the sixty-five largest cities averages about 15 per 100,000. These are alarming statistics. Couple with them the statement just made by Chief Magistrate McAdoo of New York City, that before long all of Manhattan below 14th St. will have to be one-way streets barred to pleasure vehicles, and that there are 2,000 unprotected crossings in the city where policemen are needed, and the seriousness of the motor traffic problem will be realized. Part of the trouble is due to the laxity of the driver license requirements, part to the carelesssness of drivers and their common assumption of superior right-of-way over the pedestrian at crossings, but mostly it is the inevitable result of an increase of motor use far beyond the capacity of a city street system laid out for slow moving traffic in small volume. There is little chance of this motor use decreasing or even of remaining stable. Driver and traffic regulations can only remove a part of the difficulty. The obvious solution, then, lies only in a radical revision of our conception of what a city street is for, and this reduces to a problem for the engineer. Motor boulevards, second-story streets, under or over crossings for pedestrians, all are probabilities of the near future in our congested centers and engineers responsible for our city developments must take account of such things as actualities and not as dreams.

Doubtful Distinction

ONE item in the census statistics of motor deaths stands out as a confirmation in figures of what any one may observe in person. It is the common opinion of all visitors to Los Angeles that that busy city is the worst congested in America, and that there is an unsurpassed disregard there of the accepted rules of traffic. Residents of the city rather resent this criticism; they possibly consider the cause of it only another evidence of the live qualities of the town.

What reckless driving in crowded streets means they may see when they read that in Los Angeles in 1921 the death rate from automobiles per 100,000 was 27.9; in 1920, 27.1, and in 1919, 24.1, as against an average in 1921 of 11.5 for the United States, 20.3 in Chicago, 18.8 in Manhattan, and about 15 for an average of all the large cities. Los Angeles has the doubtful distinction of killing more of its citizens and visitors with automobiles than any other city in the country. A walk or ride through its streets would lead one to expect just this, but now the figures are here to confirm it possibly the city authorities will take some drastic action to supplement the efforts the city engineer is taking to guide traffic on to safer routes.

A New Point of View

A DISTINCT step forward has been made in the study of fire prevention in wooden bridge floors which is reported in this issue. It represents a further element in the steady fight to wipe out our all-too-great fire waste. And, what is perhaps more important, it tends in the direction of improving bridge design and maintenance—the latter a much neglected subject. The subject of bridge fire prevention may appear strange; but the facts show quite clearly that a real fire danger exists, and that it is growing. If we read between the lines of the report we may judge that the danger exists for no better reason than that we have shut our eyes to it hitherto. It can be eliminated by proper care, and the committee outlines how this care is to be applied. The danger does not arise from the use of wood, but from the unskillful use of wood and from careless maintenance. In the same sense, the wooden dwelling house and the timber-frame mill building are not inherently dangerous but may be made dangerous by faulty construction and neglect. Insurance records prove that the wooden mill building is one of the safest types of structure in the world, by virtue of the fact that the points in which it formerly was dangerous were searched out by patient study. The wooden dwelling house has been made safe by the same kind of study, and we have great faith that with further development of the process it will ultimately be made fully as safe as the brick, concrete, or steel-frame house. In both cases the results are due to the point of view—to the recognition of the danger, primarily, with resulting study of how to eliminate it. Similarly the present committee report represents a new point of view of the subject of bridge floor construction. The same assurance of success attends it.

Commercial Flight

ALTHOUGH the flight of Lieutenants Macready and Kelly from San Diego to Indianapolis—more than 2,100 miles in about twenty-six hours—is a noteworthy achievement in long distance non-stop flying, it is scarcely so material a contribution toward commercial flight as was the recent demonstration at Detroit that a speed of more than 200 miles per hour is attainable. Until night flying is more practicable than it now is, we must be able to maintain a speed that will take us from New York to Chicago in a few hours and to San Francisco in not more than fifteen hours of continuous flying. Such an achievement will enable us to realize a saving in daylight time sufficient to create a demand for the service despite its high cost.

Study of Typhoid Causes Needed

ALLOCATION by causes of the steady fall in the typhoid death rate deserves searching study. This is more than a matter of giving credit where credit is due. More exact knowledge is needed for the wise direction of future work.

To what extent is typhoid reduction due to safer water supplies, to better raw milk and milk pasteurization, to the sanitary control of other drinks and foods, to anti-typhoid inoculation, to contact prevention, including the supervision of typhoid carriers, to more and better medical and nursing care of typhoid patients, to a possible increase in general health and thus in resistance to infection, and to increased appreciation by the people of the dangers of contracting typhoid and how typhoid may be avoided? A great reduction of foci of infection—infectious persons and infected and therefore possibly infectious things, such as water, milk, foods, utensils—deserves attention, particularly the immense reduction in the typhoid case rate and in associated contact risks and in the number of dangerous water supplies—such heavy and constant typhoid breeders as for years were the water supplies of Chicago, Pittsburgh, Philadelphia and many other cities.

By the aid of semi-log paper for plotting curves—a method deserving wider use—Professor Whipple shows, elsewhere in this issue, two marked decline periods and an apparent third one in the typhoid death rate, besides minor drops. The major declines he associates with (1) water filtration, beginning about 1890 and (2) dating from about 1910, milk control and pasteurization and water chlorination. Professor Whipple suggests that the sanitary engineer has claimed too much credit for the second marked stage of typhoid reduction, that of the last decade.

Intensive-extensive study of the decline of typhoid, with the full co-operation of water and health officials in individual cities seems to be needed before the decline can be sufficiently well allocated by causes to give proper credit for the notable achievements of the past or to guide the endeavors and expenditures of the future. Agreement on water fiiltration, the sanitary protection of water supplies and the adoption of improved sources of supply as the cause of the heavy typhoid decline from 1890 to 1910 seems to be general. Other causes contributed largely—doubtless relatively more largely since 1910—owing in large part to the fact that by 1910 many communities had so improved their water supplies as to leave little typhoid but what was once classed as residual.

A country-wide canvas would probably show that new filtration plants and changes to less polluted sources of supply have continued to be large factors in the reduction of typhoid in the past decade, and that a new factor, chlorination, has played a notable part. Milk control and pasteurization, while having advanced rapidly and while being of great value as health-protective measures, need to be studied carefully to find (1) their quantitative and qualitative values and (2) their reaction upon typhoid. Our impression is that whereas an improved water supply generally benefits the entire or at least a major part of the population of a city, the benefits of a new milk ordinance or a new system of milk inspection come slowly, and that pasteurization is rarely applied to the entire milk supply of a city, or even the worst portion of it, within a single year, and

in whatever degree applied is less certain in efficiency than water filtration and perhaps less efficient than water chlorination. Back of this, however, is the question, what part of the typhoid rate of a city, under various conditions, is due to the milk supply? Are there any data on the subject? Typhoid outbreaks, due to milk, are, or once were, numerous, but did even these often materially increase the average typhoid rate for five or ten years? And had not mild outbreaks of typhoid become rare by 1910, especially in the larger cities?

The water-works engineer and superintendent need to know at what point short of a zero typhoid death rate they may stop in advising capital and operating expenditure designed to lower that part of the typhoid death or case rate attributed to public water supplies. The health officer needs to know whether and if so where he may wisely direct his energies to further typhoid reduction. City governments, taxpayers and the whole citizenship need the same information for their guidance in voting money for water-supply improvements and for refinements in water-works operation, as well as in making appropriations for health-protective work along other lines.

Who should undertake the typhoid studies we have suggested? Professor Whipple has made a start that suggests the direction if not the distance such a study should go. The work might be carried further at Harvard, and at other well-equipped schools of sanitary engineering and public health, with co-operation by city and state health departments, the United States Public Health Service and the Vital Statistics Division of the Bureau of the Census. State and local co-operation are essential in securing data as to the dates when various improvements affecting typhoid were made and particularly the quantitative and qualitative degrees of the improvements and the percentages of the population benefited in each case.

Overworking a Willing Horse

ONE of the most encouraging signs of the development of the engineering profession is its growing sense of obligation to the community, but as the public becomes accustomed to this willingness on the part of the engineer to help there seems to be growing also a tendency to abuse it. Particularly is this to be observed on the part of state or municipal authorities, who have before them in the regular routine of their duty many problems of an engineering nature to be solved. When these are obviously specific, such things as the design of a sewer system or the building of a bridge, things that every one knows to be part of the engineer's daily job, they hire or retain an engineer for them and pay him as being worthy of his hire. But every so often they have to decide on questions which have only an engineering tinge or which, in their ignorance of the broad scope of modern engineering, they consider to be in quite another field. At such times they are apt to fall back on the "citizens' committee" and appoint thereto engineers on whose shoulders falls all the gratuitous work to be done.

Two such cases have just come to notice. In one state several engineers have been asked to serve on a building code committee made up otherwise of men quite unfitted to give more than perfunctory aid to the technical job of formulating a building code. If this committee succeeds in writing a satisfactory code it will be because the engineers have put in, without compensation, their time and the professional services which are their livelihood. But they will be classed along with the passive members of the committee and will take their reward in such honor as they can find in being named along with vaudeville managers and state labor department employees.

In another state a board composed entirely of laymen and with no technical staff is investigating drainage and backwater problems. In an effort to make some progress in its study the board sent letters to a number of engineers detailing the problem and asking specific advice. The board is now complaining because this questionnaire method has brought only evasive and indefinite replies, not recognizing that engineers rarely have sufficient income to permit much unrewarded professional service and second that no engineer can give a satisfactory opinion without study of facts.

What is the complaint in both these instances? It is not that the engineer is unwilling to bear an equal burden with his fellow citizens in this business of government, nor that he is unwilling to give freely of the fruits of his engineering experience in illuminating the dark corners of subjects outside the strict field of engineering. He does believe, however, that he should not be asked by the state to give that by which he makes a living any more than the butcher should be asked to give beef to public hospitals or a contractor to lay for nothing a stretch of city pavement. Individually he may want to offer his services gratis just as the butcher may want to send meat to the hospital but the former should be considered charity just as surely as the latter is so considered. It should not be a form of public service taken as a matter of course.

Such an attitude on the part of the individual engineer need not interfere with the desirable public activities of the engineering society in the study of public problems nor with the engineer's personal activities in the broader phases of public life. Much good can come both to the profession and to the community by such reports as the New Orleans engineers have just made on the Mississippi flood situation and those made by Washington chapter of the A. A. E. on the Knickerbocker failure. Those reports informed the public on important engineering situations with the authority that group action gives and in a way that would probably not have resulted from retained engineers. So also the various engineers whose brief biographies have graced our "Engineer in Public Life" column these past months are doing work which honors themselves and their profession.

The situation, then, reduces to this. Engineers believe that their habit of work and of thought and the materials with which they work entitle them to a certain respect in matters of public interest. They believe that the business of government would be helped by the consideration of views which they may have to advance on certain of its specific phases. They are anxious that their fellow citizens have the benefit of those views. They are willing freely to contribute of their time and services to the study and promotion of such activities as can not be carried on by an engineer engaged in the pursuit of his profession. For professional activities, however, they resent the solicitation of free service as unbecoming the state and unfair to the profession of engineering.

Lackawanna Continues Grade Crossing Elimination

Suburban Tracks Elevated Through East Orange, N. J.—Depression vs. Elevation Compared—Flat-Slab Elevated Structure Developed—Diverted Line Carries Traffic—Station Layout Described

TRACK elevation while continuing a heavy suburban traffic is being successfully accomplished at East Orange, N. J., by the Delaware, Lackawanna & Western R.R., by diverting the old line largely to an adjacent parallel right-of-way partly purchased and partly borrowed from city streets. With the restoration of traffic to the old alignment on the new elevated structure the right-of-way now temporarily occupied will be restored to the city in the shape of improved and partly new streets. It is in the general plan of street pre-emption, improvement and restoration that the East Orange grade elimination has interest as a construction operation. The plants for and the methods of fabricating the elevated structure are not out of the ordinary.

FIG. 1—LOOKING EAST ALONG THE MAIN ST. ELEVATION AT EAST ORANGE

The line under reconstruction is on the Morris & Essex branch of the railroad, one of the most heavily traveled of the suburban lines outside of New York. Some twenty years ago this line was depressed and three-tracked through Newark and in 1911 a start was made on the removal of grade crossings and incidental thereto the addition of a third track from the end of the Roseville cut at Newark to Mount Tabor, 27 miles beyond. The western end of this work including third tracking from Millburn east through Orange was completed as an elevation just before the beginning of the war but the extension through East Orange was held up partly by the war and partly by the inability of the railroad and the city to agree on the type of grade elimination. The railroad, for reasons noted below, held out for a continuation of the elevation; the city demanded depression. Finally, however, the city accepted the railroad viewpoint and the work now nearing completion was started.

When completed the railroad will have a three-track line—with the exception of two double-track drawbridges over the Hackensack and Passaic Rivers—from Hoboken to Millburn (17 mi.) and will have completely cleared of grade crossings both the main line as far as Mt. Tabor and the Montclair branch.

As shown in the map and profile, the new main line rises out of the Newark cut—a depression 60 ft. wide between concrete retaining walls—on a grade of 1.5 per cent, and continues with a maximum grade of 1.5 per cent to the connection with the Orange elevation, the maximum elevation of the new grade above the old being around 30 ft. In the revision are three new stations; that at Grove St., where the grade is only 10 ft. above the old, being made by raising the old station and the ones at East Orange (Main St.) and at Brick Church being new structures.

In respect to design, the grade crossing elimination assumed somewhat complex characteristics. Besides the necessity of changing a double track to three tracks and devising a station-platform arrangement which would care for a reversal each day in the direction of the loaded-train traffic and for one track of the three to return the empty trains from the two loaded-train tracks, there were required a number of unusual structures. Such in particular were the steel bridge on a 65 deg. skew at Main St., the construction of

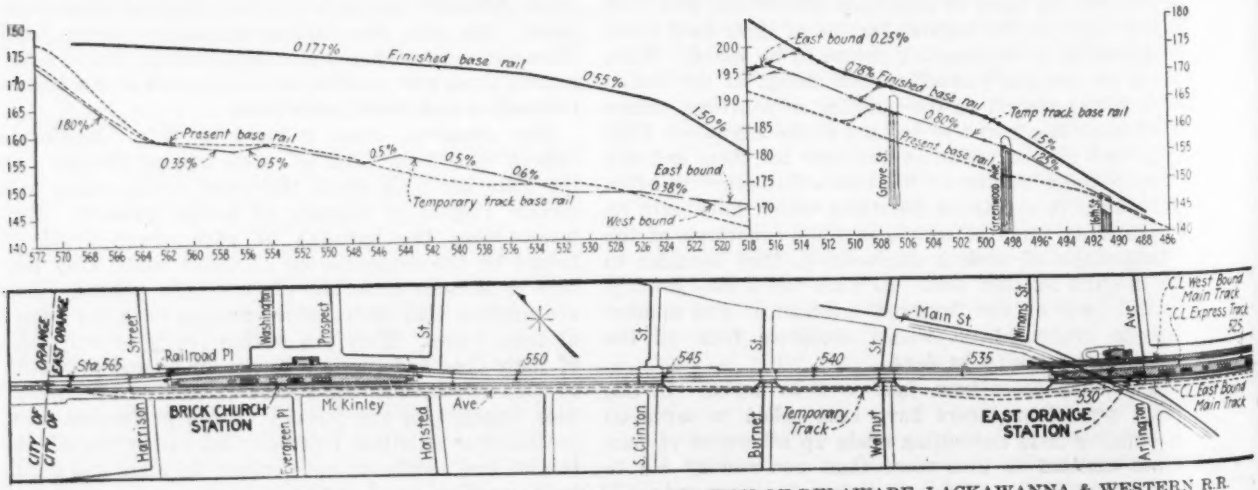


FIG. 2—PROFILE AND WEST END OF EAST ORANGE ELEVATION OF DELAWARE, LACKAWANNA & WESTERN R.R.

an 11-ft. concrete superstructure on an existing three-span stone arch at the Parkway and, finally, a most extensive use of flat-slab concrete structure for elevated station tracks and adjacent street crossings. The detailed design of some of the structures will be described in later articles.

Preceding all was the important question whether the elimination of grade crossings should take the form of track depression or track elevation, with respect to the streets.

Elevation vs. Depression—As indicated, track elevation was decided upon, the reasoning, epitomized, being as follows: Street grades and locations are more disturbed and there are more alterations in sewers, watermains and street underground structures generally when depression is adopted. A depressed track is more likely to be obstructed by articles thrown or fallen over the edges; it is a catch-all for litter and so more difficult to keep clean; its drainage is apt to be complicated. The light is poorer and the ventilation is not so good. Crossing bridges must have a 22-ft. clearance compared with 14-ft. clearance required for streets under elevated tracks. City bridges across tracks are as a rule poorly maintained and an element of danger; with streets close together, signaling is more difficult; industrial sidings ascend from the main track level and introduce the danger of cars on the sid-

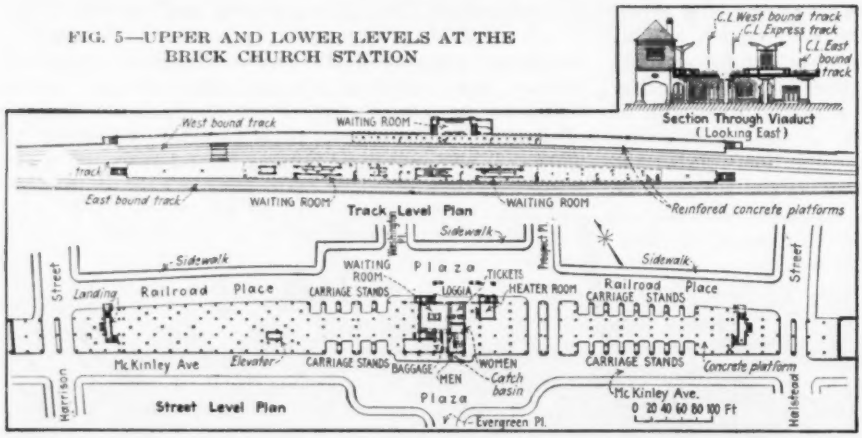
FIG. 3—AT MAIN ST., ON THE EAST ORANGE ELEVATION LOOKING WEST TOWARD THE ORANGE MOUNTAIN
Main St. crossing from left to right under steel girders carrying new elevated line.
Temporary tracks running at left on streets and purchased land.

ing breaking away and coasting down onto the main track.

With all these objections avoided, largely, by elevation the fundamental reason for its adoption was the lower cost and the better service to passengers. While the physical task of handling passengers can be accomplished quite as well perhaps from depressed tracks the requirements of light, ventilation, and vision are better satisfied by an elevated line. The passenger feels more free if he can "look out of the window" and in developing suburban traffic the satisfaction of this feeling has

FIG. 4—EAST END OF EAST ORANGE ELEVATION OF DELAWARE, LACKAWANNA & WESTERN R.R.

FIG. 5—UPPER AND LOWER LEVELS AT THE BRICK CHURCH STATION



been found to be a factor worth consideration. It is also a business advantage to the town to have its streets and structures and its business signs and activities visible to passing travelers.

However, the decisive reason against track depression was its greater cost and the fact that future enlargement would be more difficult. By elevation, somewhat steeper grades were required, but with a traffic largely of suburban passenger trains, this was not a serious drawback. As the plans worked out no grades exceeding 1½ per cent had to be employed. As electrification is contemplated at some early date—provisions being made therefor in the new structures—this grade was acceptable.

Outline of Structure—From the Newark line through East Orange to the Orange line there are 1½ miles of grade crossing elimination. Except at crossings over streets and at stations, the elevated structure is embankment or fill between retaining walls some of which ran 30 ft. high. The view, Fig. 7, shows a typical parallel wall structure for a fill and Fig. 10 shows typical wall sections. All walls are capped with a parapet and railing of either the concrete post and slab panel type doweled by projecting rods to the wall top, or of the steel angle and picket type, with posts securely anchored to the wall top. Both the wall design and the methods of constructing the walls were entirely ordinary.

Two of the street crossings called for special structures, one the skew bridge at Main St., and the other the masonry arch elevation at the Parkway. Ordinarily the street crossings are beam and girder structures on abutments and piers or flat slabs on columns. Structurally the flat-slab, reinforced-concrete elevated structure is the uncommon item. There are nearly 1,700 ft. of structure of this type at the two principal stations and adjacent street crossings.

At the Parkway crossing the original structure was a three-arch stone bridge. With the rather flat arches it seemed doubtful wisdom to raise the parapet walls and deepen the fill and thus greatly increase the load on the rings. To meet this condition and the obvious necessity of a presentable appearance, a concrete pier-and-girder superstructure, with a cloistered arch façade was built across the old masonry bridge.

The crossing at Main St., Fig. 1, was a steel bridge problem. It is on a skew of 65 deg. and the street carried double street railway tracks and a heavy vehicular traffic. The main girders and floorbeams are carried on three lines of pier columns and the floor is a system of I-beams carried by the girders and piers. A very thin and economical floor was thus secured.

On the Main St. bridge and extending east from it are the platforms and other structures of the East Orange station. At the Brick Church station farther west a similar elevated structure of a flat slab on columns is employed. Fig. 8 shows the Brick Church station platform in various stages of construction. Round columns, with the reinforcement and the caps mushroomed out into the slab, are used at both stations and neither in form or design is there anything which is unusual to structures of this type. At Main St. the elevated structure averages about 75 ft. wide and is 850 ft. long, and at Brick Church the structure is about 1,065x75 ft. The columns are spaced about 20 ft. on centers. For these situations, elevated passenger stations, the flat-slab, reinforced-concrete structure was found to offer the combined advantages of economy and good appearance and usable room underneath for parking vehicles and for merchandising and storage.

At street crossings the columned structure gives particularly good visibility for motor car traffic. In the East Orange elevated structure generally, even where it is a fill between walls running square up to the crossing streets, attention was carefully given to get clear vision both in approaching and in emerging from under-track street crossings. The use of columns helped in this object as also did beveling off the corners where retaining walls and abutments met.

FIG. 7—LOOKING EAST ALONG THE ELEVATION AT WESTERN END OF WORK
Temporary tracks leave main right-of-way to the right.

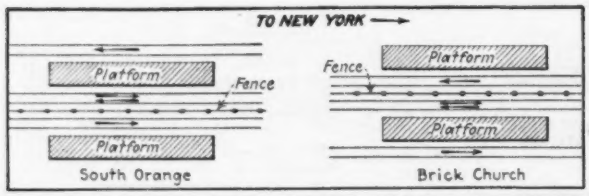


FIG. 6—COMPARATIVE PLATFORM LAYOUTS AT SOUTH ORANGE AND BRICK CHURCH

Stations and Track Layout—In accordance with the practice of the Lackawanna the stations are exceptionally pleasing in appearance and convenient in layout. The Brick Church station, shown in plan in Fig. 5, illustrates the layout. Here the elevated structure is a flat slab 1,065 ft. long on columns spaced approximately 22 ft. c. to c. On either side of this for its full length runs a marginal street which widens out into a small plaza opposite the station entrance. In the middle of the structure is located the station proper, with the baggage, waiting, ticket, etc., rooms at the street grade beneath the track slab and with waiting rooms and umbrella sheds on the two platforms above. Extending out from the station at the street grade are paved platforms for indented carriage stands, one through passageway and, on one side, space which may well be utilized for store purposes.

At Main St., the general idea of the plan is the same, but is modified because of variation in street conditions, particularly because of the sharp skew with which Main St. crosses the railroad right-of-way. Grove St. is a local station with no approach to the center track.

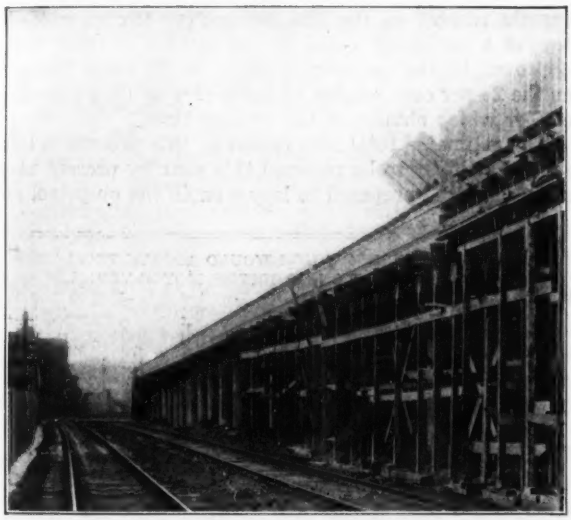


FIG. 8—STAGES OF CONSTRUCTION AT THE BRICK CHURCH FLAT-SLAB STRUCTURE

Track layout at the stations was designed best to accommodate the commuting traffic which moves toward New York in large numbers in the morning and from New York at night. Exigencies of schedule require that trains move variously on the right outside or the center track, though of course as a rule local trains use the outside tracks and express trains the center. The layout at Brick Church, followed also at Main St., is designed for stations which handle both express and local traffic. As is noted in Fig. 6, New York bound platform is between the express and east bound tracks so that the morning commuter knows that his train, no matter which track it is running on, may be reached from this platform. The home-coming commuter, however, may be discharged on either platform.

At South Orange, in the earlier elevation, a different layout is used, as shown also in Fig. 6. Here the governing idea was to provide easy transfer from outbound local to express trains, South Orange being the end of the local division for many of the evening trains as scheduled.

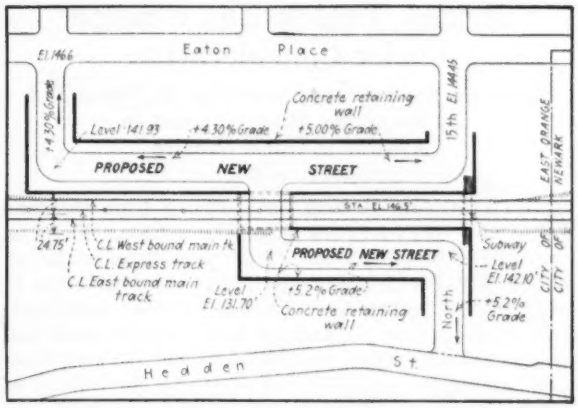


FIG. 9—SPLIT UNDERCROSSING AT N. 15TH ST.

Street Changes and Additions—Except in changing the grades of streets in dipping under the elevated structure, street changes and additions were planned largely either to provide for temporary tracks to carry traffic during construction or to eliminate crossings as at N. 15th St. (Fig. 9). Here where the line begins to rise onto elevated structure from the Newark cut, railway grade is only about 5 ft. above street grade and it required too great a dip in the street to pass it under the tracks. The new street arrangement illustrated was adopted. It will be noted that the footwalk is carried under the tracks on the line of the street but that the roadway approaching from the south turns west and runs parallel to the track until clearance can be provided, when it dips under the tracks and comes out on the north side to split into two roadways running east and west to the nearest cross-street.

Ordinarily parallel streets could be taken over for the temporary tracks, as shown in the view in Fig. 7, but in other stretches of the work right-of-way had to be bought. By swinging the temporary tracks clear of the old right-of-way for most of the length of the elevation a clear site was left for the new construction, although in places side clearance was so small that the new structure had to be built for two tracks only and these tracks put in service first.

Construction was divided into three sections each with its separate contractor. The contractors are: F. M. Talbott Co., Hyde-McFarlin-Burke Co., and H. F. Curtis, Inc., all of New York, N. Y. George J. Ray is chief engineer and O. H. Kellog is engineer in charge, Delaware, Lackawanna & Western R.R.

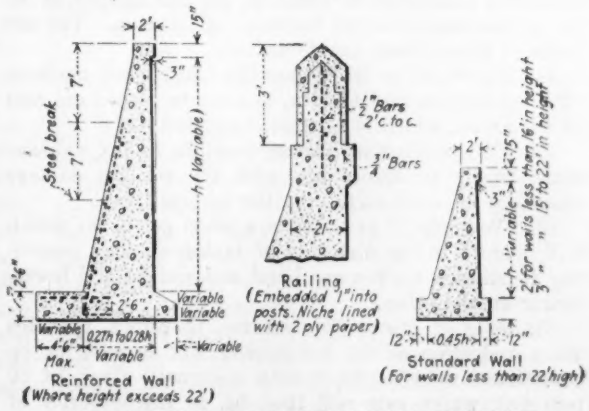


FIG. 10—TYPICAL RETAINING WALL SECTIONS

British Vehicle Tax Change Under Consideration

Proposed Return from Road Tax to Petrol Tax Is Receiving Much Support in Answer to Questionnaire

(London Correspondence)

AGITATION in Britain for a return from the road tax on vehicles to the petrol tax is based chiefly on the unfairness of the tax of £1 per horse power on vehicles fitted with pneumatic tires. The agitators in favor of the return have emphasized that pneumatic tires do practically no damage to well-made roads and have quoted with effect the evidence available both from tests carried out in the United States by the Bureau of Public Roads, and also by tests carried out in France under the direction of the Ministry of Public Works. These tests show that pneumatic tire deflections are proportional to the load applied and that the cushioning properties are retained at the end of a blow. Solid tires show an increased density of rubber and unit intensity of loading under increasing weights, and cushioning is decreased accordingly The curve of rear wheel impact relative to speed shows a rapid increase with a solid rubber tire and practically no increase in the case of the pneumatic tire.

In response to this agitation the Automobile Association and Motor Union, the all-powerful body in Britain, sent a questionnaire to its members with a view to ascertaining to what extent the desire for a return to the petrol tax was general The result of this questionnaire indicated that less than 1 per cent were opposed to a return. (The membership of the A. A. and M. U. is now about 160,000.)

Transport Ministry to Act—Various interested bodies are meeting in endeavors to arrive at a common policy in view of the inquiry to be made by the Ministry of Transport into the whole question of vehicle taxation. Among the matters on which a common policy has yet to be formulated are the appointments of the total burden of taxation as between privately-owned passenger vehicles and utility and public vehicles of various sorts. A point still requiring solution is: With the increasing burden on motorists owing to heavy taxes, cannot more revenue be brought in by adopting a policy which will insure an increase in the number of motor vehicles to be used by reducing the scale of taxes per vehicle?

Various alternative schemes of vehicle taxation are being investigated by the Ministry of Transport, and the most important of these is the one submitted by E. L. Leeming, Council Surveyor of Barton. The objects of this scheme are threefold:

(1) To retain as far as possible the present methods of licensing and registration, and not to exceed the cost of collecting, which is estimated at £350,000.

(2) To endeavor as far as possible to tax vehicles more nearly in accordance with the relative damage caused to the road surface by the various types.

(3) To apply, if practicable, a small petrol tax which will operate in the direction of taxing vehicles according to mileage on the one hand and weight and horsepower on the other.

Elements of Plan—This scheme, therefore, provides for a reduction of the horsepower tax on cars, or on commercial vehicles fitted with pneumatic tires, of 50 per cent, which rate will then be, in the majority of cases, 10s. per horsepower; in the case of motorcycles with or without sidecars, or three-wheeled vehicles, the same rate would be applied. Thus, for an 8-hp. motorcycle the charge would be £4 per annum, whereas for a 2½-hp. "lightweight" the charge would be 25s., all subject, of course, to a minimum tax of £1 per annum.

In the case of commercial goods vehicles, motor-omnibuses, char-a-bancs, etc., where these are fitted with solid rubber tires the tax should be at the rate of 30s. per horsepower, i.e., three times the rate charged for pneumatic tires and 50 per cent above the present tax. The object of this tax (which would be applied equally to petrol, electric, or steam vehicles) is to place, within limits, the burden of cost of road maintenance upon the traffic which is responsible for such damage, and, at the same time, to offer a direct inducement to owners of vehicles to convert their solid tires into pneumatic equipment. It is understood that rear wheels are to be considered, and not merely front wheel conversions, because it is the rear wheels mainly which destroy the roads and cause corrugation.

With regard to cushion types, of which certain types have the effect of reducing the impact on the road surface, it is suggested that the committee should offer certain rebates on the 30s. horsepower tax on production of a certificate issued by the makers of those tires approved by the committee, much in the same manner as the 25-per cent rebates on motorcars of 1913 date and earlier which obtains at the present time.

The estimated total sum raised by this process is less than that likely to be received this year by present taxation, and it is proposed to levy a small tax on petrol on

ESTIMATED REVENUE WHICH WOULD ACCRUE FROM THE PROPOSED TAXATION OF BRITISH MOTOR VEHICLES.

Class	Est. licenses for 12 Months Ending Dec. 31, 1923.	Est. receipts for Licenses for 1923.	Licenses to May 31, 1922.	Receipts for licenses To May 31, 1922
		£		£
1—Motorcars fitted with pneumatic tires, taxed at 10s. per hp.	290,000	2,200,000	276,221	4,188,629
2—Motorcycles, etc., taxed at 10s. per hp.	350,000	420,000	335,796	784,556
3—Invalid vehicles (no change)	313	78	313	78
4—Commercial goods vehicles fitted with solid tires, taxed at 30s. per hp.	150,000	4,400,000	144,674	2,790,120
5—Road locomotives (no change)	2,400	47,000	2,314	44,810
6—Motor ploughs (no change)	15,000	3,800	14,549	3,637
7—Motor tractors, etc. (no change)	1,500	19,500	1,399	18,280
8—Motor hackneys taxed mainly at 10s. per hp. as pneumatic tires vehicles	80,000	700,000	74,939	1,305,938
9—Tramcars (no change)	13,600	10,200	13,559	10,172
10—General identification licences (no change)	10,000	72,000	9,460	68,841
	912,813	£7,872,578	873,174	£9,215,061

Note: The comparison of this table with that issued by the Finance Department of the Ministry of Transport, showing the receipts to May 31, 1922, shows a reduction of approximately 4 millions to 2 millions on motorcars and pneumatic-tires vehicles, and an increase of 50 per cent on commercial goods vehicles.

importation, which, however, may be varied slightly from time to time to produce a sum equal to approximately 2 or 2½ millions, thus making the gross receipts equal to 10 millions or thereabouts. It is not intended, however, that the petrol tax should exceed, say 3d. per gallon, nor is it proposed to tax benzole, kerosene or other fuels. The tax, being small, may be levied as a flat rate for either refined or crude spirit.

Vehicles driven by steam or electricity will, therefore, only escape the small petrol tax—an advantage which is certainly deserved, since these vehicles are propelled by home fuel. Where petrol is used for purposes other

than road transport, and rebate is desired, permits or certificates for such rebate could be issued to those consumers purchasing the fuel in bulk, say, 50 gallons or over. Those purchasing petrol in small quantities would be unable to obtain this rebate, which would not justify the expense in making such allowances, nor, on the other hand, impose any great hardship on small consumers. The estimated cost of collection will, therefore, be approximately the same as that of the present year.

The present method of carrying disk licenses in a prominent position on vehicles may be retained, except that a change of shape of license could be instituted to distinguish between the pneumatic tire license and the solid tire license. For instance, the solid tire license might be oval or rectangular shape, and the pneumatic tire circular. This would render the detection of any attempt to defraud the authorities comparatively easy.

The taxation of motor omnibuses, it is maintained, should not be reduced, but, rather, should be increased, unless the vehicles are fitted with pneumatic tires. It is well known that similar types of vehicles plying on the same route, repeating the journeys day by day, have a far more destructive effect than the same number of different types of vehicles performing the same journeys.

An increased tax of 33 or 50 per cent should be imposed for trailers, and iron tires should be prohibited.

A minimum thickness or depth of rubber for worn solid tires should be formulated in all cases.

The scheme outlined above would have the effect of encouraging owners to dispense with solid tires and adopt pneumatics, which might, in the first instance, cause some reduction in the amount received for licenses of this class of vehicle. This, however, should be looked upon favorably, because, in a very short time, the reduced damage to roads would make itself felt, together with a corresponding reduced cost of maintenance which would obviously necessitate a less sum of money for grants to the various road authorities; also, it would give a distinct fillip to the motor trade generally.

Gage of Light Railways in South Africa

The question of building pioneer and agricultural development lines on the 24-in. gage instead of the 42-in. standard gage of the South African Government Railways is under discussion in regard to twenty-two lines aggregating 850 miles which are now projected by the Railway Department. Although cheap construction is proposed for the standard-gage lines, by the use of light track and a minimum amount of station buildings and other facilities, the cost per mile is estimated at $22,000 for these lines as compared with $8,800 for two narrow-gage lines which are included in the program, the latter estimate making no allowance for possible future widening. The narrow-gage advocates point out that the lower cost would enable a greater mileage to be built and freight rates reduced. On the other hand, the standard-gage advocates consider that the cost for this gage could be reduced materially by using rails lighter than the 60-lb. weight proposed, and using ties 5½ ft. instead of 6½ ft. long, with 1,760 ties per mile. The farmers are said to prefer standard-gage lines. Another suggestion is to follow a practice used extensively in continental Europe by building narrow-gage lines along the highways, thus largely eliminating the cost of right-of-way and grading. The train crews would handle freight and perform the work now done by the station agents and their assistants.

An Experience with Air-Binding of Rapid Filters

Water Supersaturated at Leaking Pump Glands Gave up 2,600 Gallons of Air in Filters at Highland Park, Mich.

By William D. Hatfield
Superintendent of Filtration, Highland Park, Mich.

TROUBLES with accumulations of air in the sand and gravel beds of rapid sand filters are usually attributed to a rather high concentration of algae growth in the water which clogs up the sand beds and also causes a supersaturation of dissolved oxygen; to washing the filters at too great a loss of head, or to leaks in the sides or bottom of the filters through which air is drawn into the bed after a negative head is reached. The respective remedies for such troubles are copper sulphate to kill the algae, a wash at a less loss of head and calking the leaks in the filter walls or floor.

Since the filtration plant at Highland Park, Mich., was put into use in November, 1920, periodic troubles with air accumulations in the sand beds have been experienced. This accumulation of air cut the period of service of the filters from 20 to 50 per cent and at times when typical air-binding occurred, the filters had to be washed or "blown-out" every four to nine hours. Ultimately the source was located as a defective gland packing in the pump suction.

The advisability of "breaking" or blowing out the air by opening the wash-water valve without wasting is questionable, but it is often necessary in order to get enough water through the filters to supply the demand. At such times reliance for sanitary safety must be placed on chlorination.

The Highland Park plant is a modern 12-m.g.d. rapid sand filter plant and in a general way differs from the average only in that it is situated 11½ miles from Lake St. Claire, the source of the raw water, and that the raw water is pumped to the plant by the Detroit Edison Power Co. instead of by the city. The raw-water pumps consist of three centrifugal pumps operating at 1,800 r.p.m. under a head of 140 feet. The raw water as it enters the mixing chamber is treated with from 0.4 to 1.0 gr. per gallon of alum, and after 20 min. mixing remains in the coagulation basin from four to six hours. The head of water on the sand beds is 5 ft., the depth of the sand and gravel bed is 4 ft. and the average level of the water in the clear well is 2 ft. below the level of the underdrain system, thus making the total available head for operation 12 ft. Under normal operation the filters are washed with a 23-in. rise per minute of the wash water when the loss of head has reached 10 ft. Experimentally the filters have been washed at from 4 to 12 ft. loss of head and at various rises per minute of the wash water. The rate of filtration has varied from 75 to 155 m.g.d. per acre.

During the first month of operation of the plant the length of service between washings of the filters was from 12 to 20 hours, and on washing a considerable amount of air was always found in the beds. From December, 1920, until May, 1921, very little trouble was experienced from this accumulation, though occasionally on opening the wash-water valve large quantities of air would blow out of the sand, resembling a regular air wash. During this time the period of filter service was about 25 hours. Beginning May 15, 1921,

serious air-binding of the filters occurred and the runs of the filters lasted only from four to nine hours. At such times it became necessary to "blow out" the filters as soon as the loss-of-head indicators took a sudden drop, but the filters were not washed until the normal period of 24 hours was reached.

Weekly microscopical analyses were started in March, 1921, before the serious air troubles began. The total number of micro-organisms varied from month to month from 50 to 125 per c.c. and consisted of a miscellaneous collection of Tabellaria, Asterionella, Fragilaria and other Diatomaceae. It was felt that these organisms in such small numbers could not be causing the trouble. Scraping the fine sand from the surface of the bed seemed to solve the problem, for from May 25 to June 5 the air troubles were abated and the length of filter service was from 30 to 40 hours. However, the trouble returned on June 6 and lasted until the latter part of July. During August typical air-binding did not occur but at the end of 20 hours' service the loss of head gradually fell to 10 ft. On washing the air fairly blew the sand off the gravel so that great care was needed in opening the wash-water valve.

Since the trouble could not be traced to algae or fine sand, attention was turned to a different method of operation. Variations in the alum dose and in the volume and velocity of wash water had no effect. When air-binding was not serious it was often possible to wash the beds at a loss of head of from 4 to 6 ft. without finding an accumulation of air, but during periods of air-binding the air started accumulating at a loss of head of 2 ft. an hour after the filter was put in service, and small air bubbles would rise from the surface of the sand through the 5 ft. of treated water on the beds. At these times air could be found in the filters at any loss of head after the first hour of service. During the latter part of August air did not accumulate in the beds until a loss of head of more than 8 ft. was reached. It was therefore possible to wash the filters at an 8-ft. loss of head without finding air in the beds. From September, 1921, until February, 1922, no air was found in the filter beds even though they were washed at a 10- or 12-ft. loss of head.

Dissolved Air—Analyses of the influent water for dissolved oxygen during periods of air-binding showed that it was from 115 to 135 per cent saturated with oxygen, while analyses of the combined filter effluent often showed a reduction of the supersaturation to 105 per cent. There was no reduction of carbon dioxide. Before the cause of this supersaturation was located the saturation dropped to less than 100 per cent and no more trouble was experienced. A crude analysis of gases given off from the filters when washed indicated that it contained about 30 per cent oxygen and 70 per cent nitrogen. The influent was therefore not only supersaturated with oxygen but also with more than twice as much nitrogen. In other words the water was often 135 per cent saturated with both oxygen and nitrogen or air. From the relative solubilities of oxygen and nitrogen in water when under their partial pressures of the atmospheric air, from the temperatures and from the parts per million of dissolved oxygen, it is possible to calculate the number of cubic centimeters of air that are dissolved in a gallon of the water. The following table gives results of a typical analysis made during air-binding troubles. From these data it is easily seen that a filter which had passed 1 m.g. would have removed approximately 2,600 gal. of air from the water. Is it any wonder that the sand beds fairly blew up when they were washed?

RESULTS OF ANALYSES ON APRIL 4, 1922

Source	Temperature Deg. C.	Dissolved Oxygen P.P.M.	Air per Gallon, c.c.	Saturation Per Cent
Influent	4	15.8	120	120
Effluent	4	14.5	110	110

Note: It happens at this temperature that the cubic centimeters of air per gallon and the per cent saturation are identical, but as the temperature increases the cubic centimeters of air per liter are lower than the per cent saturation.

When the air troubles began again in February, 1922, an analysis of the lake water showed it to be 98 per cent saturated with dissolved oxygen (or air) while the water entering the filter plant was 127 per cent saturated. An investigation showed that air was being drawn into the pumps around the packing glands and under the high pressure was dissolved in the water. The water arriving at the filter plant was again at normal pressure and highly supersaturated. On passing through the coagulation basin the supersaturation was not reduced, but as soon as the water entered the sand the air was given off even though no negative head existed.

The raw-water pumps are designed with a water seal so that if the packing is loose water should leak out instead of air leaking into the pump. The water-seal pipes were found to be plugged with packing and other material, so that the water seal was not functioning Also a defective connection was found where a water line was tapped into the suction line of the pumps. After cleaning the water-seal piping of obstruction and repairing the defective connection with the suction line, no more supersaturation of the raw water occurred and no air has been found in the beds on washing. The raw-water pumps are now operated with the packing glands of such tightness that a little water leaks out all the time. The amount of wash water has been cut to less than 1 per cent and the average run of the filters varies from 40 to 70 hours, depending on the rate of flow.

Carbon and Manganese and the Strength of Steel

New experiments made at the Bureau of Standards, and reported in a scientific paper by R. P. Neville and J. R. Cain, just issued, define the effects of carbon and manganese on the mechanical properties of iron quite precisely. The experiments were made by testing annealed specimens from 3-lb. ingots made from electrolytic iron in a pure magnesia crucible in an electric vacuum furnace. It was found that carbon increases the ultimate strength at an average rate of about 1,000 lb. per square inch per 0.01 per cent of carbon up to a content of 85 to 100; the rate of increase was the greater for the higher manganese ratios. Carbon increased the Brinell hardness in about the same ratio as the ultimate strength, but the elastic limit was less affected than the ultimate strength. On the other hand, elongation and reduction of area decreased rapidly. Manganese had but little effect on the properties of the iron, in the absence of carbon. With the addition of carbon its effect increased proportionately with the carbon content. The ultimate strength of the metal was raised by 90 to 250 lb. per square inch for each point of manganese, and the Brinell hardness in about the same ratio. The proportional limit was increased more than the ultimate strength, while on the other hand the ductility was changed but slightly.

Making Separator and Diffuser Container Blocks

Manufacture for Aeration Units of Milwaukee Sewage Works Carried Out by Force Account—Cost Data Given

By R. R. Lundahl
Division Engineer, Milwaukee Sewerage Commission, Milwaukee, Wis.

A TOTAL of 24,400 precast concrete containers and separator blocks for the air-diffuser plates for the Milwaukee activated-sludge plant are being built by day labor forces under the direction of the engineering staff of the Milwaukee Sewerage Commission. Tentative designs of the blocks and containers were submitted to the makers of forms, subsequently to be changed in minor details to suit the conditions arising from the preliminary castings. A casting plant was laid out for a production of from 40 to 80 castings per day, including a mixing plant, a steam curing room, assembly tracks and storage space of about four acres for the 24,400 separate pieces. The plant was started in February, 1921, and the work will probably be completed by the end of 1922. Aside from the design of the castings, forms and plant, this article will deal with shop routine, difficulties encountered, costs, and handling of the crews to obtain speed and efficiency.

Except in special cases each container accommodates nine filtros plates. As designed, the container is 10 ft. 2 in. long, 18 in. wide, and 6⅝ in. deep. The extra depth provides an air reservoir under the plates after they are set in the container. Fig. 1 is reproduced from a working drawing of a nine-plate container block. The other blocks vary in length, depending upon the number of plates to be accommodated. The plates will be cemented in place after the containers are set in position.

The entire floor area of the aeration tanks, raw sewage feed channels, mixed liquor channels and the return sludge channels are to be covered with container and separator blocks. In fact every portion of the plant floor area, except where the velocities are great enough to prevent deposits and in the sedimentation tanks, is to be covered by such blocks and containers. The blocks and plate containers are set alternately over the entire area mentioned, forming a hoppered or saw-tooth bottom.

About 9,000 containers are required for the entire plant. The blocks are to be set alternately with the plate containers, approximately 7,600 separator blocks

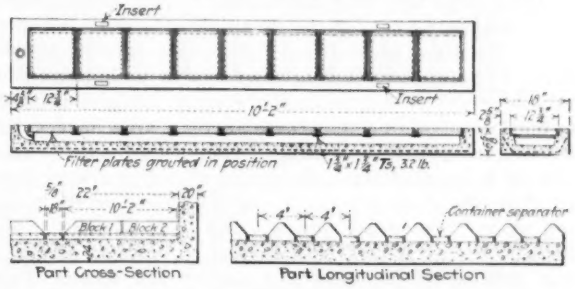


FIG. 1. NINE-PLATE CONTAINER BLOCK AND LOCATION WITH REFERENCE TO SEPARATOR BLOCKS
The inserts are for use in handling the container. The elbow at the left end is for the air-pipe connection.

being required. The separators are much easier handled if in two pieces, so the several blocks are made one half the length of the containers. This makes 15,200 separator blocks or a grand total of 24,400 separate pieces to be cast. After investigation it was found that it was cheaper to precast the separator blocks than to cast them in place.

Plant—The manufacture of these separator blocks and plate containers could have been included in the general contract for the sewage - works but this proved to be impracticable because it would require more time to do this work than to complete the disposal plant ready for the installation of the blocks and containers, unless a very large plant for the manufacture was established, which would necessarily entail an excessive overhead cost for each casting. A report was prepared by our engineers comparing the advantages, costs, etc., of the manufacture of the castings by day labor and under the direction of the Sewerage Commission and by contract. After reviewing the report, the commissioners authorized the manufacture of these castings by day labor, in a plant to be erected on Jones Island.

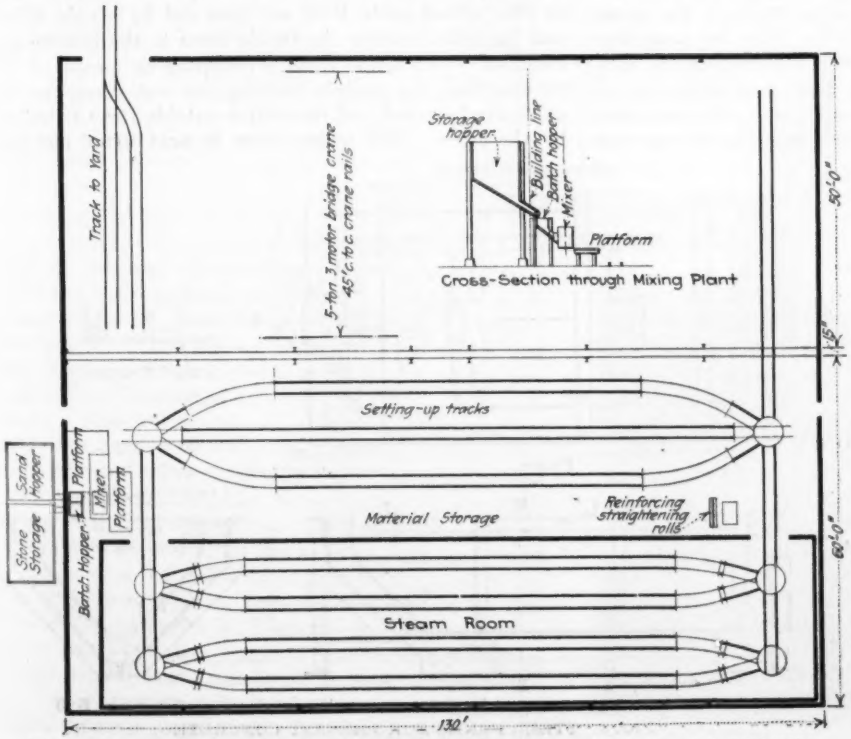


FIG. 2. HOPPER MIXER AND TRACK LAY OUT IN BLOCK CASTING BUILDING

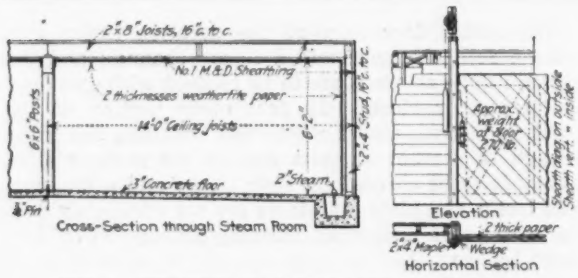


FIG. 3. HEATING METHODS AND DOOR SEALS IN STEAM ROOM

The ground area required was 130 x 110 ft. and as the work was to be carried on at all seasons the area was covered with a steel frame, sheet-iron covered building. Fig. 2 shows a floor plan of the building. The mixing plant is fed from the storage hoppers located outside the building and these in turn are charged by a locomotive crane operating a clam-shell bucket. The cement is handled manually and is stored in a shed just south of the storage-hoppers and convenient to the mixing plant. The steam curing room is of particular interest. Fig. 3 shows the construction, method of heating, method of handling and sealing the doors. The general arrangement of the tracks within the rooms and a ventilating fan are not shown. This room will accommodate 80 castings at a time. It can be heated to a temperature of 115 deg. F. shortly after the doors are sealed. The live steam is discharged into gutters containing water, thus producing highly saturated steam which was necessary to prevent the concrete from baking rather than curing.

It was not deemed necessary to make forms for all the six types of separator blocks since by a few changes the forms for blocks 1 and 2 could be used for the other types.

It was estimated that 60 forms each of the three types—the container form, and the form for separator blocks 1 and 2—would be required to maintain the estimated capacity of the casting plant and take care of renewals and repairs. This number was delivered early in May, 1921. The actual work of making castings was started the latter part of May.

Sequence—The sequence of operations in the manufacture is as follows: The forms are assembled on industrial cars equipped with special frames made to accommodate the forms, two forms to each car, the triangle mesh reinforcing for the casting being placed in the form as it is assembled. The assembling floor is equipped with three tracks, accommodating 80 forms, although this number is seldom on the floor at one time. The north bay of the casting plant is shown in Fig. 6, in which the assembling tracks and cars are plainly seen. As the forms are assembled the cars pass in front of the concrete mixer, shown at the far end of the bay where they receive the concrete from a specially constructed bucket handled by a small electric hoist operating on a trolley. As the concrete is placed in the forms it is thoroughly spaded by four men, two on either side of the form. After receiving the concrete, the cars pass into the steam curing room shown on the left of Fig. 6. This steam room will accommodate 160 castings at a time. At the end of a day's run the doors of this room are closed and sealed. The steam is then turned on and maintained until 6 a.m. the following day, when the doors are opened and the ventilating fan started. This cools the room in time for the workmen to enter at 8 a.m. the same morning. The cars with the castings are then run out of the steam room and placed under a bridge crane which picks up the frame of the car from the trucks, placing the same with the two forms and castings in the storage bay of the plant, shown in Fig. 7. The crane now places a new frame on the car, with two dis-assembled forms, and the car returns to the assembling floor. Here the forms are thoroughly cleaned and oiled before being assembled again. By noon the correct complement of cars and castings has been removed from the curing room and placed in the storage bay.

Stripping Forms—In the afternoon of the same day that the castings are removed from the curing room the forms are stripped. In the original design it was intended that the whole outside form would have to be taken apart, this, however, was found to be unnecessary.

The operations in removing the container form (in which the container is cast upside down, see Fig. 5) are as follows: The tie angles P-17 are removed by taking out the key wedges while the forms are yet on the car frame. The form is then picked up by the bridge crane by means of a special shackle that hooks into the end of the form in holes provided for that purpose. The load being eccentric the form immediately turns over. The wires holding the adjustable inserts to the bottom plate P-18 are now cut by a cold chisel and the bolts holding the inside form to the bottom are removed. The inside form is collapsed by means of the turnbuckles, the wedges holding the end forms to the sides are loosened and the entire outside form lifted off by the crane. The inside form is next lifted out and

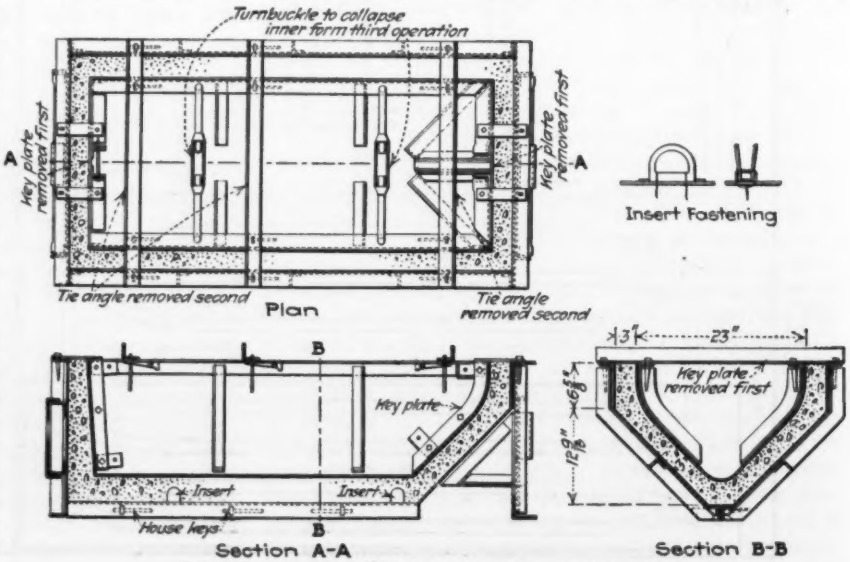


FIG. 4. STEEL FORMS FOR PRECAST CONCRETE SEPARATOR BLOCKS

placed in the outside form and the entire form goes back to the assembling floor.

In removing the forms for separator block 1, the key plates P7 and P12 (Fig. 4) of the inside form are first removed, then the tie angles P11 and the form is then collapsed by means of the turnbuckle and lifted out by the crane. The form and casting are then turned over, the insert wires cut and two sets of wedges in each end loosened, which permits the outside form to be lifted off. In the case of block 2 where both ends are straight the same process is followed but in attempting to remove the inside form, as designed, considerable trouble was experienced. In the design of block 2, a bevel of 1 in. in the ends of the forms was allowed to permit withdrawing. Experience showed that the least projection on the form prevented its removal, the result being that we finally had to remodel the inside form and make it the same as used for block 1. After this was done we

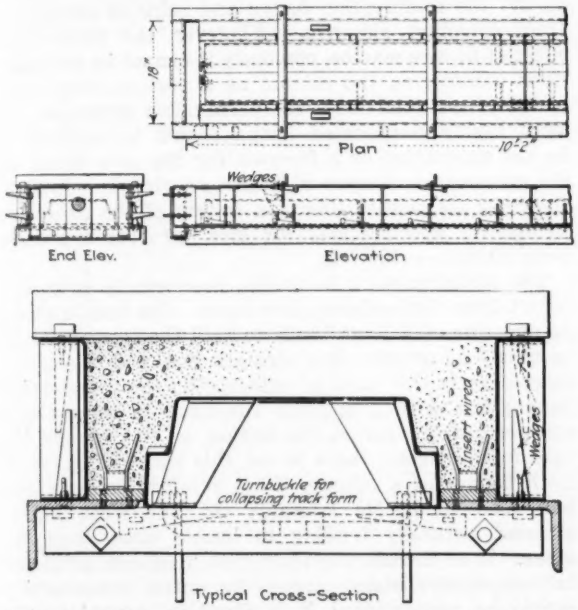


FIG. 5. STEEL FORMS FOR FILTROS PLATE CONTAINERS

experienced no further trouble. The amount of concrete in each No. 2 block was increased slightly but not enough to increase the cost materially. Trouble with this form greatly reduced the output of the plant in its first few weeks of operation but at the present time the forms are all operating satisfactorily, for which due credit should be given to the Blaw Knox Co. and to our engineer, Mr. Trenkamp.

After a few weeks' use it became evident that the turnbuckles furnished with the container forms were not satisfactory. For collapsing the forms they served the purpose admirably, but in spreading or strutting out the forms they were found to be too weak. Instead of acting as a strut they would bend up, and as a result the forms were not held to shape. This trouble resulted in a new type of turnbuckle designed by Mr. Trenkamp, constructed as follows: To the head of a $\frac{3}{4}$ x 1-in. machine bolt a $\frac{3}{4}$-in. nut was welded, placed on edge, the thread in the nut being at right angles to the bolt. The nuts for each turnbuckle were right- and left-hand threads respectively. The hexagon hand nuts were then removed from the old turnbuckles and new

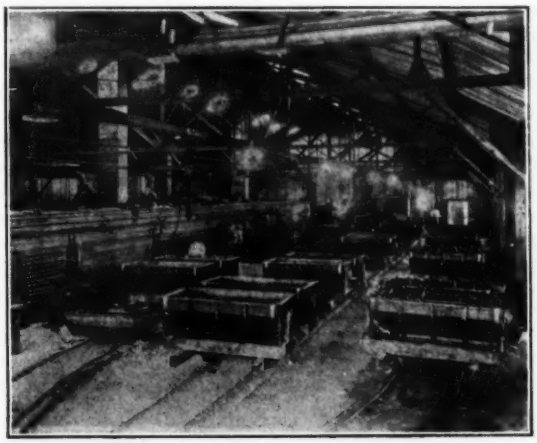


FIG. 6. NORTH BAY OF THE CASTING ROOM SHOWING ASSEMBLY FLOOR AND STEAM ROOM AT LEFT

rods with right- and left-hand threads were welded into these nuts. These new rods were then threaded into the nuts, which were welded to the bolts and the bolts inserted in the old holes in the forms formerly used for the hooks on the old turnbuckles, and held securely in place by a nut. These new turnbuckles act truly as struts and have the advantage of always being held securely in the form with no chance to drop out, which happened with the old type with the hooks.

After the forms have been removed the finished castings are placed on small industrial cars by the crane and carried to the storage yard, where they are removed from the cars and piled four high by means of a hand derrick. As the space fills up, the industrial and derrick track is shifted to make further room.

Output—The operation of the plant was started late in May, 1921. During June a regular daily output was maintained, but at a rate far below the expected capacity, with a unit labor cost of $3.65 per casting. Starting in July the rate was increased to 34 castings per day; in August, to 55; September, 62; October, 65; since which time (for about a year) the average has been maintained above 65 per day, reaching a maximum of 82, with an average labor cost of $1.75 per casting. This increase of nearly 100 per cent was procured without any expansion of the facilities, but by their more intelligent use, better arrangement of the

FIG. 7. REMOVAL SPACE AND STORAGE BAY FOR BLOCKS AFTER STEAM CURED

work and increased efficiency of the men doing the work.

In the original plan of organization the men were placed in groups so as to become proficient in their particular work. This grouping did not prove to be satisfactory because a man's absence disrupted the entire organization. It is now the practice to rotate the several crews every week or two, which prevents them from becoming "stale" and also familiarizes each man with every operation of the plant so that he is ready to take any position to which he may be assigned. This arrangement does not include the crane or concrete

FIG. 8. BLOCKS IN STORAGE YARD WILL FINALLY COVER FOUR ACRES

mixer operators, but we have relief operators for these positions.

The mixture of concrete used in the castings is 1:1½:3, the aggregate being washed materials. The crushed gravel is a special size ranging from ¼ to 1 in. which makes a very good concrete and one easy to spade in the narrow forms. The sand is a well-graded washed torpedo sand.

The original estimated cost of these castings was $10 each, including the cost of material. The cost to date has averaged less than $7 each, which includes the cost of buildings, equipment, repairs, forms, etc., amounting to approximately $50,000. The total cost will be about $175,000.

The cost of production is much lower than was anticipated and is certainly much lower than any contractor would have bid to manufacture them, as it was new work of a special character on which basic information for bidding was not available.

Up to Oct. 1, 1922, the plant had produced 23,781 castings out of a total of 24,400. The number of rejects or culls in this entire number was only 29. It is expected that the whole number will be completed by November, 1922, reducing the estimated time by six months.

There are 30 men employed in the casting plant and 4 men in the storage yard. The work is in direct charge of Frank Trenkamp, division engineer of the Sewerage Commission, and it is due to his work and supervision that the efficiency of the plant has been so materially increased.

Walter Genrich, senior engineer, is in charge as foreman of the plant. This work is being done by the Sewerage Commission of the City of Milwaukee, of which T. Chalkley Hatton is chief engineer and James L. Ferebee is principal assistant engineer. A Laurie Kurtz, division engineer of design, rendered material assistance in designing the plant and equipment.

Lateral Strength of Columns Subject to Flexure

Serious Errors Arise from Disregard of Tendency to Buckle in Direction Normal to Plane of Bending

By C. R. Young
Associate Professor of Structural Engineering, University of Toronto

EXAMINATION of the literature of structural design shows a frequent disregard of the tendency of steel columns subjected to flexure to fail in a direction at right angles to the plane of bending. Apparently, the view held by some writers and designers is that the state of flexure in a column somehow manages to restrain the column perfectly against lateral buckling transverse to the plane of bending, in some such manner as the tension flange of a beam assists the compression flange and helps to prevent it from crippling sidewise. Whatever the restraining effect of flexure may be, obviously it cannot be complete. Even considering the column as a vertical beam subjected to an axial load, the permissible stress on the most highly compressed flange should be arrived at by the application of a formula for the safe stress on the compression flanges of beams or girders. A characteristic formula of this type is that of the American Bridge Co. specifications for steel structures, namely $p = 19{,}000 - 300\ l/b$.

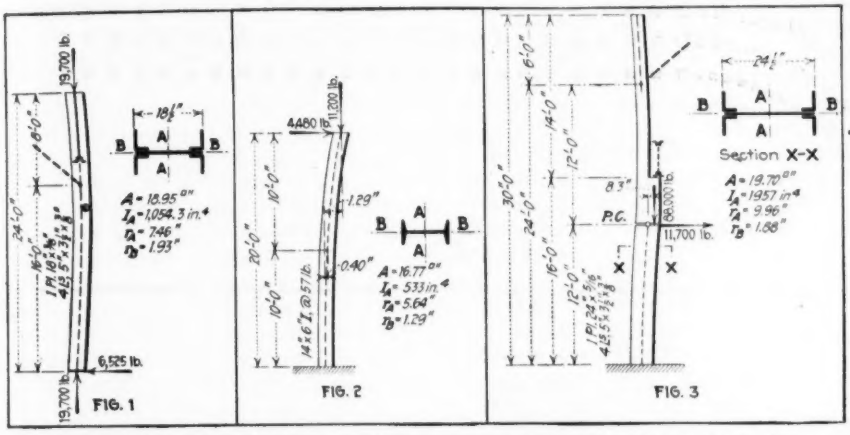
The situation with a column, however, is quite different from that existing in a beam. The tensile stress on one side of a beam tends to hold the tension flange as nearly as possible in a straight line, and to a lesser extent exerts this kind of influence on the compression flange; but with a member subjected to compressive stresses entirely across the section, as is normally the case for a column, there is not this restraining effect. Both flanges of a column, if subjected to compression, will tend to buckle laterally, the one most highly stressed naturally tending to buckle more than the other. It is therefore evident that a column subjected to compressive stress across its entire cross-section should be proportioned in a direction normal to the plane of flexure as a column than as a beam, and consequently that formulas applied to such a case should be of the column type rather than of the type applicable to the lateral buckling of compression flanges of beams.

A characteristic instance of the neglect of the flexural tendency in the weak direction of a column is contained in an example in one of the best-known American textbooks on structures. This case is that of a side column for a mill building, shown in Fig. 1. The columns are 24 ft. high, are considered as pin-ended at the base, and have a kneebrace connected to them 8 ft. down from the top. A truss 6 ft. deep runs from column to column along the sides of the building, but the author disregards the stiffening effect both of this truss and of the girts on the column, and assumes that the columns transversely to the plane of bending should have a limiting slenderness ratio of 150. Nevertheless, in the investigation of the assumed section the maximum stress at the kneebrace connection, amounting to a total of 12,090 lb. per sq.in., is compared with a permissible stress of 19,950 lb. per sq.in., based on the radius of gyration in the direction of the plane of bending. Had the radius of gyration at right angles to the plane of bending been taken, the permissible stress (after allow-

ing for an increase of 50 per cent applicable to this case of combined stress) would amount to 8,355 lb. per sq.in., or much less than the calculated existing stress.

Protest against this criticism might be made on the ground that if the maximum combined stress is calculated at the kneebrace connection the permissible stress should not be based on the situation at mid-height of the column, where the lateral buckling tendency is greatest. If, however, the maximum stress be calculated at mid-height of the column, it is found to be 9,340 lb. per sq.in., or substantially more than the stress allowed by the formula.

In a well-known English text-book on structures, the design of a column to meet the conditions shown in Fig. 2 is discussed. The actual combined stress at the base of the column, assuming that the section used is a British standard beam section 14 x 6 in. at 57 lb., is 14,300 lb. per sq.in., or less than the safe allowable flexural stress on mild steel. If, however, the state of affairs existing at mid-height of the column be investigated, it is found that the maximum combined



THREE CASES OF COLUMNS WEAKEST IN PLANE TRANSVERSE TO PLANE OF BENDING

stress at this level is 7,850 lb. per sq.in. Applying any characteristic column formula applicable to a slenderness ratio such as this, that is 186, it is found that the maximum allowable stress at right angles to the plane of bending is less than 4,000 lb. per sq.in., although in the example under consideration the author passed the design as sufficient.

A case of lateral buckling transverse to the plane of bending that is very likely to be overlooked is that of a mill building column fixed at the base and subjected to flexure. The column shown in Fig. 3 is sufficiently heavy to withstand the maximum combined stress at the base, assuming 20,000 lb. per sq.in. to be a safe unit for the mixed loading, but it does not meet the requirements at a section, for example, midway between the base and the crane-girder seat. At this mid-section the maximum combined stress is 12,560 lb. per sq.in., allowing for the effect of deflection of the vertical cantilever below the plane of contraflexure. Assuming the permissible stress to be on the basis of $p = 16{,}000 - 70\ l/r$ plus 25 per cent for the combination of dead, snow, wind and crane loading, the safe stress is only 11,060 lb. per sq.in. Evidently, therefore, such columns should be investigated at this mid-point, unless they are adequately supported at right angles to their webs by girts or special struts.

By no means all the text-books on structures are misleading or silent in this regard. A considerable number examined by the writer indicate an appreciation of the inherent weakness of a column transverse to the plane of bending and make adequate provision for it. It is felt, however, that attention should be drawn to the erroneous treatment of this subject in a number of text-books, so that junior designers may be on their guard.

Rubber Seal Rings Solve Hydraulic Turbine Problem

THE rapid increase in the size of hydraulic turbines within recent years, as well as the increase in the heads for which units of this type have been built, have brought the designer of such units many new problems. One of the most important of these has been the design of seal rings suitable for such units, particularly where the water contains silt or abrasive particles and where, on account of high heads, the water leakage around the turbine runner is more than ordinarily serious.

About a year ago, Ely C. Hutchinson, general manager and chief engineer, Pelton Water Wheel Co., began experimenting with rubber seal rings. The results have been so successful that the seal ring problem has been solved, thus removing this barrier to the further development of high speed, high capacity, hydraulic turbines.

In the experiment and study directed toward finding something better in the construction of turbine seal rings, the ideal sought was a design and construction which would avoid (1) leakage between stationary and rotating parts, (2) wear between parts, (3) danger of seizure between rotating and stationary parts or danger that a shutdown might be caused by the assembly of the turbine runner slightly out of the exact center, or even having a slight eccentric movement on account of the necessary clearance within the main steady bearings.

After the use of rubber seal rings had been found to show encouraging results, experiment was made in hardness, quality and clearances of rubber rings. Rings now being made are of a thickness that leaves no free clearance between the moving and stationary parts and the hardness used is about equal to that of automobile tire casing. The results are: no danger of seizure, no leakage and negligible wear after almost a year's operation under adverse conditions; and no damage to the interior of the turbine from rubbing between rotating and stationary seal rings.

At the Kaweah No. 2 power house of the Southern California Edison Co. rubber seal rings have enabled the plant to develop more power under the same hydraulic conditions and with better operating characteristics.

In announcing the success of experiments with rubber rings, Mr. Hutchinson acknowledges the co-operation of H. W. Dennis and H. L. Doolittle of the Southern California Edison Co. and C. O. Poole and F. O. Dolson of the Southern Sierras Power Co.

Design Features of the University of Kansas Stadium

Structure Is Part of Memorial to Students Who Died in War Service — Study of Existing Stadiums Made as Preliminary to Decision on Type

By Clement C. Williams
Lately Professor of Civil Engineering, University of Kansas; Professor of Civil Engineering, University of Illinois

THE stadium at the University of Kansas is being built as one part of a memorial to students and alumni who sacrificed their lives in the World War. From a variety of ideas as to what would constitute a satisfactory memorial, opinion finally crystallized about two structures—an athletic stadium and a University union building. The former is completed and plans for the latter are being prepared. The campaign for funds, contributed by university alumni and friends, is about ended.

Before beginning the design of the stadium the writer visited all of the large college stadiums in the country, in order to secure information and points of view on the general type of structure and the character of facilities to be provided. In this connection, he wishes to acknowledge the ready responses to inquiries and helpful suggestions from directors of athletics and designers of stadiums in the various institutions.

The four outstanding types of stadiums are (1) the bowl, (2) the natural basin type, (3) the side-hill type and (4) the grandstand or elevated structure. The Yale Bowl, which is the only example of the first class, was formed by excavating a huge pit with sloping sides in a level field, piling the spoil around the rim as an embankment, and then placing the seats on the slope of the excavation and embankment, the playing field being at bottom of the pit. The structure forms a complete and enclosed oval in plan and it is intended to accommodate football contests only.

In the second class, advantage is taken of an existing recess in the topography to lay the structure on the natural slopes of an open basin, in the bottom of which may be placed the athletic field. More or less grading of the slopes and the bed of the basin or valley to accommodate the structure and the field is usually necessary and in some cases a portion of the structure rests entirely upon artificial supports, as in the Syracuse stadium. This type is further illustrated by the stadiums at Tacoma, San Diego, the University of Washington, and others.

As examples of the third, or side-hill type, may be mentioned the stadiums at Cornell, Washington University (St. Louis), and College of the City of New York. In these cases, the structure is laid on the natural slope

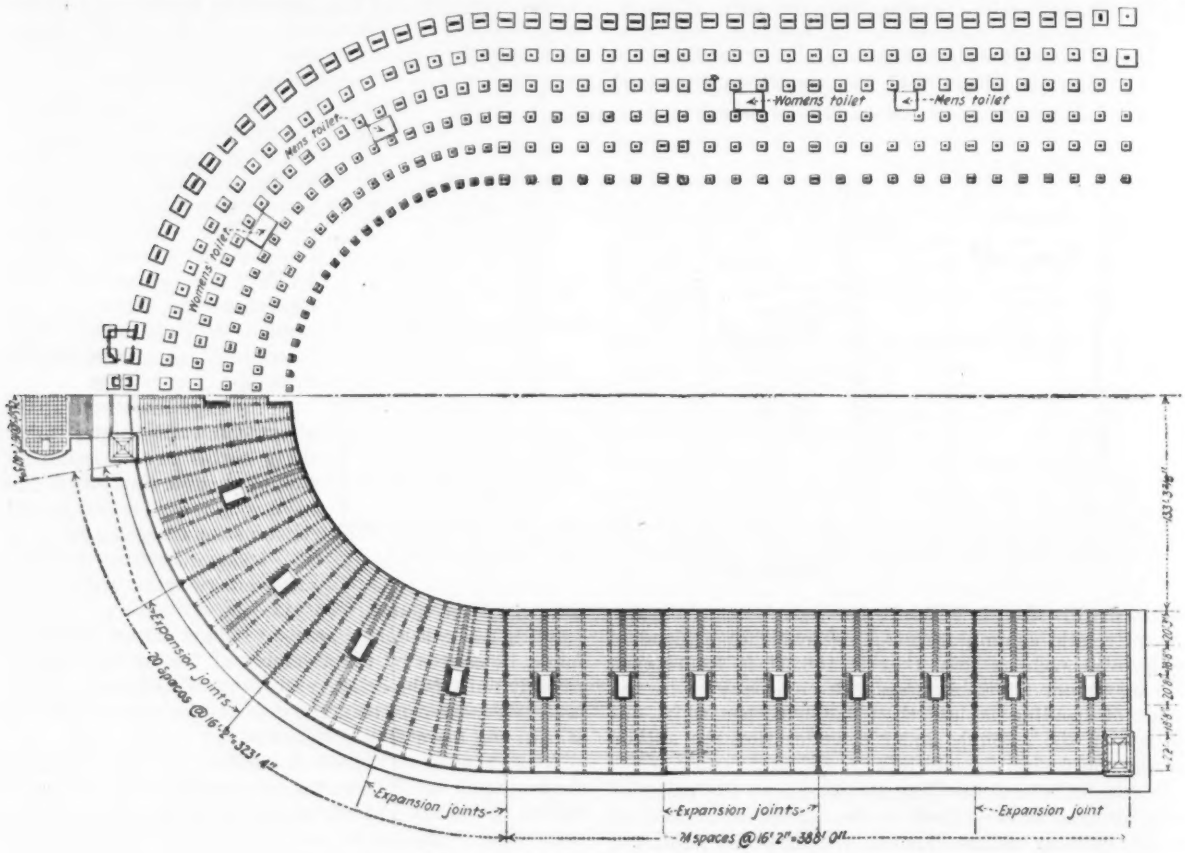


FIG. 1—PLAN OF KANSAS STADIUM

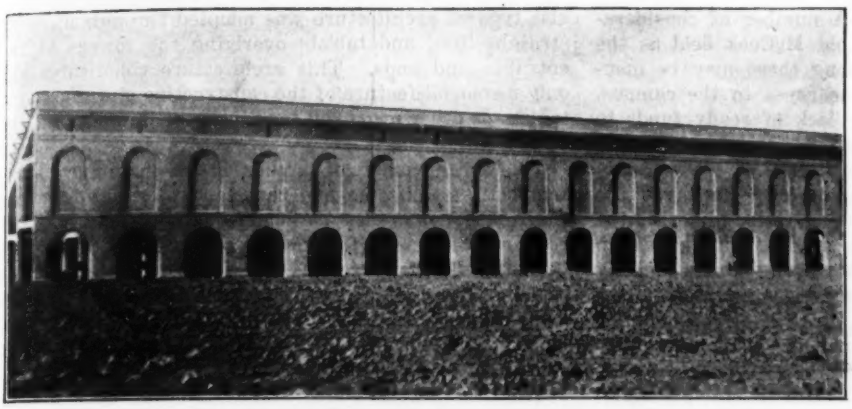


FIG. 2—ARCHITECTURAL FEATURES OF KANSAS STADIUM

of a hill side with a certain necessary amount of modification by grading, and the athletic field is placed at the foot of the hill, the seats being on one side of the field only.

The fourth class includes those structures erected entirely above the ground level and resting on artificial supports entirely. It is illustrated in the stadiums at Harvard, Princeton, Chicago, and Ohio, the one proposed at Illinois, the proposed municipal stadium in Chicago, and the Pershing stadium in France, the open air theater at Milan and several at baseball grounds. The prototype of this class is the Coliseum at Rome.

Choice of Type—In the Kansas stadium, it was essential that as many sports as possible should be accommodated, hence a closed bowl was not feasible on account of the requirements for track. Moreover, the stagnation of air in a sunken bowl with the consequent ratardation in the drying of the field after a rain and other attendant difficulties, inclined the decision away from the bowl type. Furthermore, no site near the university was peculiarly adapted to the sunken bowl or to the side-hill type of structure, and our observation had been that in the matter of maintenance and the variety of facilities provided for, the advantages lay with the Harvard or Princeton type. Therefore this type was selected.

One important consideration which affected the choice was the space under the stand which becomes available for sheltered track events. A few institutions have utilized this space to a great extent and the possibilities of its use counted heavily in the choice at Kansas. In fact, a considerable expenditure was incurred in additional grading and drainage to make this space utilizable. The accessibility of this space for shelter in the case of showers was an important consideration.

From these and other factors, the type of stadium chosen was a U-shaped structure consisting of two straight sides enclosed at one end by a half circle. The advantages of improved vision (which are more psychological than real) claimed for curved sides did not appear to compensate for the added expense of construction involved. The entrance to the stand is from the rear up stairways which lead to the center of gravity of the seating sections. While this arrangement is somewhat more expensive than one allowing entrance from the front, the added convenience in seating, the minimizing of walking in front of seated spectators, and the rapidity of exit after a game seemed to justify the increased outlay. It was estimated that the width of stairways would permit the emptying of the stands in six minutes and the results at the last game accorded with this estimate.

Small stairs are provided at the bottom of the stand to permit egress of spectators to the field should occasion warrant. A side doorway was provided at the main entrance at the middle of the closed end to permit a parade led by the band to march directly on the field.

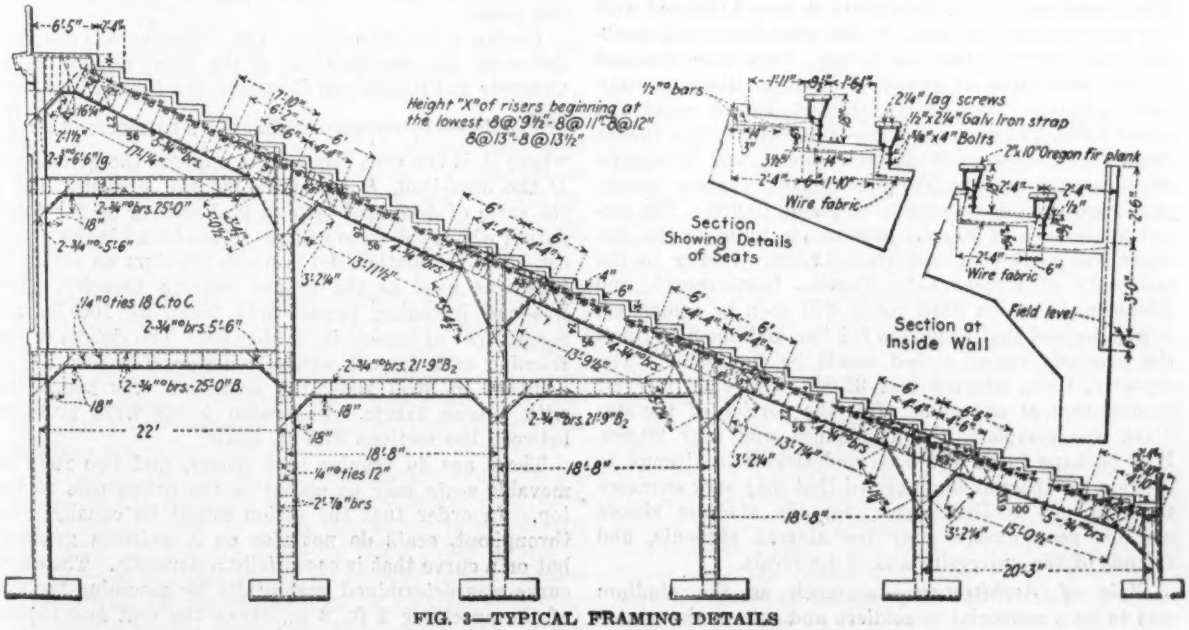


FIG. 3—TYPICAL FRAMING DETAILS

Location and Accessibility—A number of considerations influenced the choice of old McCook field as the site of the new stadium. Among these may be mentioned, (1) accessibility, (2) nearness to the campus, enhancing the availability, (3) lack of ready funds to purchase an extensive site, and (4) sentiment in preserving the traditions of McCook field.

The university lies outside the city limits at the southwest corner, hence by placing the stadium at the north side of the campus it was at the point nearest to the center of the city and, therefore, became readily accessible from the three railway stations and from the hard surfaced highways that are being constructed through Lawrence. The street car line to the university passes on one side of the tract.

In selecting the location the matter of stable foundations and freedom from excessive ground water also constituted important factors. In some places in Lawrence, the slipping of strata has caused serious difficulty, hence, an effort was made to avoid difficulty from this source.

Some effort was made to orient the stadium so that the rays of the sun at the middle of the football season would be at right angles to the field, but too much in the way of appearance and accessibility would have been sacrificed to accomplish this, so the structure was made to lie on a north-and-south axis, which is essentially the axis of the topography and of the campus. The stadium opens directly towards the central administration group of buildings, this placement affording the spectator a panoramic view of practically the entire university.

The stadium is slightly less than two city blocks wide, and as it is centered on Alabama St., it is approachable from two other well-paved streets leading directly to the parking spaces at either side. In addition, direct approach may be made from a side street by McCook Ave. which leads from the street car line and connects to one of the main approaches to the campus.

Data on Design—The first question to be determined in the design was the probable future seating capacity. The attendance at the University is over 4,000 and with the present rate of increase the attendance will probably reach 8,000 in the near future. Data were obtained on the attendance at games at other institutions similarly situated when their student bodies numbered about 4,000, and now, when they number 8,000 to 10,000. Important games at Michigan, Illinois, and Wisconsin draw crowds of from 20,000 to 26,000, whereas twenty years ago they drew crowds of about 10,000. The record attendance at Kansas previous to building the stadium was somewhat less than 12,500. Owing to the proximity of Kansas City, Topeka, Leavenworth, and Atchison, to which hard roads will soon be completed, it was decided that provision for two and one-half times the previous record crowd would be justifiable. The capacity, then, adopted was 32,000. It is of interest to note that at one game after the portion of the stadium was complete, the attendance was over 20,000. It is perhaps futile and even undesirable to attempt to provide for the maximum crowd that may seek entrance to a famous football game, for the stadium should perhaps accommodate only the alumni, students, and friends of the university and of its rivals.

Style of Architecture—Inasmuch as the stadium was to be a memorial to soldiers and sailors the memorial type of architecture was adopted throughout, with straight lines and tablets overlying the towers at the entrance and ends. This architecture constitutes the only memorial feature of the construction since no name tablets or other memorial inscription will appear on the structure.

The arrangement of arches at the outer wall resembles the Coliseum and the Harvard stadium except that the upper arches are blanked, in order to hide the reinforced-concrete framework of struts and columns beneath. Special care was taken also to place all these skeleton structural members in such positions that they would not be visible from the outside, the only ones being the stairways leading to the entrances to the stand.

The two towers which stand at either side of the main entrance rise but slightly above the skyline of the structure and are of simple straight-line design. Each tower carries two tablets surmounted by a flag pole. Inasmuch as it was obviously impossible to make these towers sufficiently large and imposing to dominate the structure, as primary masses, they were subdued to

FIG. 4—ARCHES GIVE PLEASING EFFECT

less conspicuous features and the stadium was treated as one mass.

Design of the Structure.—The structure was designed following the specifications of the Joint Committee on Concrete and Reinforced Concrete; the foundations were proportioned by means of Schneider's formula: $A = \frac{D}{Br}$, where A is the area required to support the given load, D the dead-load, B the allowable soil pressure and r the ratio of dead-load to total load coming on the foundation where the ratio of live- to dead-load is the greatest. The foundation bed is a clay stratum on which 1½ tons was used as the proper bearing capacity. The live-load including impact was taken as 100 lb. per square foot of horizontal projection. The details of the framing of a typical section are shown in Fig. 3. In addition to steel rods, the seat slab was reinforced with a wire fabric. Expansion joints were provided between the sections 97.5 ft. apart.

There are 40 regular seat spaces, and two rows of movable seats may be placed in the promenade at the top. In order that the vision might be equally good throughout, seats do not rise on a uniform gradient but on a curve that is essentially a parabola. The exact curve was determined graphically by assuming the eye of the spectator 2 ft. 8 in. above the seat and having

a clearance of about 4 to 8 in. over the eye of the spectator in the seat in front. Beginning at the lowest the heights of the risers are as follows: 8 to 9½ in.; 8 to 11 in.; 8 to 12 in.; 8 to 13 in., and 8 to 13½ in. The exact amount of this clearance varies as shown in the table below where the clearance in the Kansas stadium is compared with that used at other institutions.

	To Side Line, Clearance in Inches			To Center, Clearance in Inches		
	2nd Row	Halfway	Top	2nd Row	Halfway	Top
Chicago	3	2	3	4½	8	8
Harvard	...	4½	4	14	10½	10
Yale	4½	3	4	...	...	...
Michigan	4⅜	4½	3⅜	7½	7½	7
Kansas	5⅛	5⅛	4⅛	7⅛	8⅛	7⅛

Design of the Field—The proper design of the field was fully as important as the stadium itself, for unless the field should be successful, the entire project would be a failure. In fact, approximately 25 per cent of the total cost was involved in the grading, draining and otherwise preparing the field and site. The facilities provided on the field are the football gridiron, a standard quarter-mile track 21 ft. wide with a 220-yd. straight-away at one side, and temporary accommodation of the baseball diamond. A layer of the top soil of the field was removed, and 6-in. tile drains laid approximately on 50-ft. centers. Above these drains a 6-in. layer of cinders was laid over the entire field, and above this 10 in. of sandy loam. The surface was then sodded with blue grass sod. The top of the field as well as the drains slope from the center of the field to the edge on an approximately 0.5 per cent grade.

FIG. 5—OPEN END SECTION OF STANDS
Though flat the parabolic curve of the seating area is clearly noticeable at the end wall.

The track is 21 ft. wide and lies around an oval with straight sides 330 ft. long and semicircular ends with 104.4 ft. radius. It slopes 2 in. to the inner edge and is underdrained at 50-ft. intervals. It consists of a layer of 12 in. of screened cinders with a 4-in. top layer of one part clay and three parts cinders screened through a ½-in. screen. On top was a ½-in. dressing of cinders of ¼-in. size.

It was important to secure adequate drainage and yet to retain sufficient moisture in the ground above the drains to prevent the grass dying, during the drought periods characteristic of Kansas summers. By using cinders instead of crushed rock, which has been employed in humid regions, it is believed that this problem has been met fairly well.

Acoustics—Practically no information could be obtained on the acoustics of stadiums, hence, no definite consideration could be given this factor in the design. For most satisfactory cheering effects, the volume of sound from one side should go directly to the opposite side without serious dissipation. A stadium with overhanging balconies may have some advantage in this respect. In the single slope type of structure, 100 ft. or more wide, obviously the cheers from the back rows reach the opposite stand some 300 ft. away a fraction of a second later than from the front rows. A curious phenomenon is observable from the portion of the structure completed, namely that certain low tones of the yells are affected differently from the higher tones. No trouble has been experienced from echo effects.

Accessory Facilities—One of the details which was given considerable thought was the seats. It was desirable to devise comfortable, durable seats without undue expense. For comfort and to prevent certain pathological consequences, it was desirable to have seats at about the height of a standard chair. Backs were removed from consideration because of the direct cost and the indirect expense resulting from the space which they occupy causing a wider spacing of seats and hence a wider stadium. Oregon fir planks, 2 in. x 10 in., supported on galvanized strap-iron frames were adopted as seats and have been found entirely satisfactory. The galvanized iron frame was chosen to harmonize with the concrete and to prevent rust stains. The seats project 4½ in. beyond the face of the concrete benches on which they rest so that rain water flowing over the benches will not injure clothing and also that the feet may be drawn under the seats when necessary. Rather liberal public toilet space has been provided, because observation at certain other university stadiums showed the urgent necessity of such provision.

An office, team room, locker room, shower room, and storeroom are provided under each end section of the structure, one side being intended for the 'varsity and the other for the freshman team and visitors, the two layouts being alike. An inclosed passage from the team room leads directly to the field.

In the completed arrangement tickets will be sold from movable cages through openings in the iron fence which will surround the stadium, and will be taken up at turnstiles which admit to the inclosure.

The first and third bays under the seats are available for sheltered track events during winter, and the second, which is partly occupied by structural members and stairs may be used for storage. The outer bay has ample headroom for the principal field events.

Provision for Extension—So indefinite were the data on the attendance used in determining the stadium capacity that possible future extension necessarily had to be taken into consideration. The scheme for extension considered most feasible consists of extending the straight sides outward and cantilevering a balcony over the portion already built. The foundations of the present structure were not designed to carry such a balcony, hence added width would have to carry this added load.

Construction—The contract for the portion of the stadium completed was signed July 9, 1921, and the 15,000 seats were ready for use Nov. 24, the completed portion constituting three of the four sections of the straight sides, in both legs of the U.

The stadium was designed under the direction of the writer as consulting engineer. F. L. Brown, assistant professor of mechanics; Laforce Bailey, assistant professor of architecture; and L. H. Dodd did the detailed designing. Much of the architectural treatment is due to Professor Bailey. The Unit Construction Co. of St. Louis were the contractors, with E. H. Hartman as superintendent of construction. L. H. Dodd served as resident engineer on construction.

Cause of Decrease in Typhoid Rate in the United States

Curves Plotted on Semi-Log Paper Accentuate Drop After Water and Milk Supplies Improved—Two States and Six Cities Figured

BY GEORGE C. WHIPPLE
Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

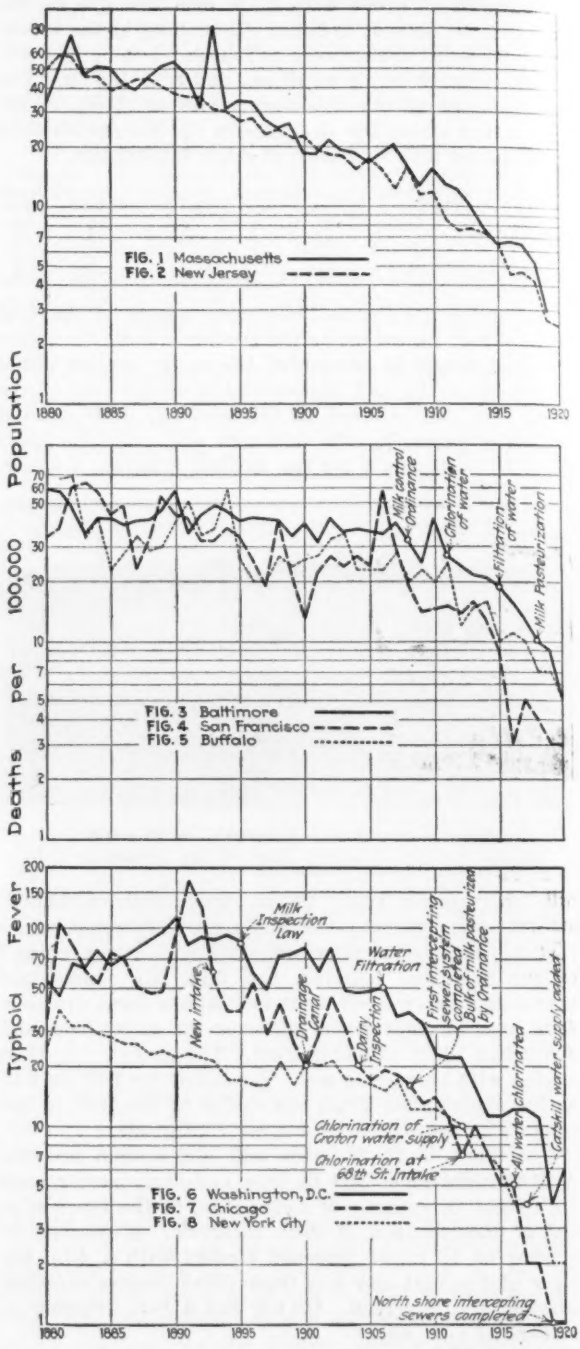
DURING the last thirty years the typhoid fever rates of the United States have been decreasing. Sanitary engineers have naturally claimed credit for this decrease, as water purification was the factor which gave these rates their first down-hill push. Perhaps they are inclined to assume too much of the credit for the typhoid fever decline. If so, this may be attributed in great measure to the way in which the data have been studied.

The annual typhoid fever death-rates of such a state as Massachusetts, if plotted on ordinary cross-section paper, show a continuously falling curve. Few of the water supplies of this state are filtered or chlorinated, and the other changes certainly have not been enough to account for the decrease. One studies the curve in vain, because the eye is not keen enough to detect differences in the curvature at different times. If, however, the same data are plotted on semi-log paper, as shown in Fig. 1, it will be noticed that twice since 1880 there have been changes in the general slope. The first change occurred about 1888 and followed closely after the improvements in water supplies made under the inspiration of the early work of the Massachusetts State Board of Health. The second occurred about the year 1909 and coincided with the period (1908-10) when improvements in milk supplies were being actively pushed, when pasteurization was being put into practice. A curve (Fig. 2) similarly plotted for New Jersey shows the same break in 1910 as that for Massachusetts; in fact, the two curves are surprisingly alike throughout, showing the direct relation of improvements in the water and milk supply to the typhoid situation.

If similar plottings are made for large cities, it will almost invariably be found that the downward slopes of the plotted typhoid rates began to accelerate somewhere between 1908 and 1910 (see Fig. 3 to 8). The change of rate about this time was so marked, was so general over the country, and applied to so many cities where the water supply did not change in character during those years, that the cumulative evidence makes it seem almost certain that the great decline in typhoid fever in the United States during the past decade was due very largely to the pasteurization of milk supplies. In some instances there are evidences of another change of slope about 1918, which may possibly be related in some way to the typhoid vaccination practiced so completely in the army during the war. Sufficient time has not elapsed to prove this.

But it must not be forgotten that the chlorination of water, which began about the same time as milk pasteurization, has also been an important factor in the decline of typhoid. The effect of filtration is too well known, indeed, to need more than bare mention.

It is hoped that sanitary engineers and epidemiologists will use the method of semi-log plotting for analyzing the changes which are gradually occurring not only in the death-rates for typhoid fever, but for other diseases. Miss A. D. Hamblen, statistician of the Massachusetts State Department of Public Health, has recently made many such plots for the various causes of death in Massachusetts, sometimes with surprising results (see U. S. Public Health Reports, Aug. 18, 1922). The writer wishes to acknowledge her work as a pioneer in this field, although the method itself is not a new one.



FIGS. 1 TO 8—TYPHOID FEVER CURVES FOR TWO STATES AND SIX CITIES
Ploted on semi-log paper to accentuate breaks in curves. Changes affecting curves indicated where known.

Hogged Fuel Used Instead of Oil In Portland Dredges

Despite Greater Convenience of Fuel Oil, Four Dredges on Columbia River Find It More Economical to Burn Mill Refuse

THE PORT of Portland, Ore., operates four dredges on the Columbia and Willamette rivers, all of which are now burning hogged fuel, the ground-up refuse from lumber mills. Two of these dredges are equipped to burn either hogged fuel or fuel oil. The question of which fuel is the more economical has been studied in the light of changing prices and local conditions with the conclusion thus far in favor of the fuel from the local mills. However, the price of fuel oil at Portland has dropped materially in recent months and on Aug. 25 was about $1.25 per bbl. If this decreases to $1 per bbl. it is believed that because of the convenience and the reduction in labor and equipment necessary to use hogged fuel, it would be preferable to burn oil if the hogged fuel cost remained $1 per unit at the mill. However, as oil prices decline the price of hogged fuel per unit—that is, 200 cu.ft.—should do likewise.

LOADING HOGGED FUEL ONTO DREDGE AT PORTLAND, ORE.

The fuel is brought alongside the dredges in the barges which are tied up close to the boiler room side hatch. Extending out from the dredge is a boom carrying an endless chain bucket conveyor which feeds from the barge into the dredge storage room.

Some of the factors that affect this problem follow:

Reasons cited by the Port of Portland for favoring hogged fuel are (1) its comparative economy, (2) its local origin which eliminates danger of interruption due to transportation difficulties and (3) the desire to encourage mill operations that might not be feasible without a market for hogged fuel.

Difficulties or objections to the use of hogged fuel are (1) the cost of equipment and labor problems involved in handling so bulky a commodity, (2) variation in fuel values with the grade of timber being cut, moisture content, etc., (3) losses and delays due to the necessity of taking and paying for the entire output of mills when dredges are not operating continuously; also the shortage of fuel that results when the mills shut down, (4) B.t.u. losses suffered by hogged fuel when stored, which may amount to as much as 40 per cent with fine material when stored five to six months.

Up to 1906 the Port of Portland dredges burned slab wood. Since that time hogged fuel has been used with the occasional supplemental use of oil. The use of both fuels simultaneously is advantageous when moisture is unusually high in the mill refuse.

Of the four dredges, one requires for its operation a total of about 400 hp., two require about 1,500 hp. each, and the fourth about 2,000 hp. When all four are in continuous operation their total requirement is about 5,800 units of hogged fuel per month. In order to be certain of having a continuous supply of this amount it has been considered necessary to make contracts with the mills. The Port of Portland has been taking, under a contract price of $1 per unit, the entire hogged fuel output from five sawmills. After adding delivery and handling charges, the cost of the fuel on barges alongside the dredge has been $2 per unit.

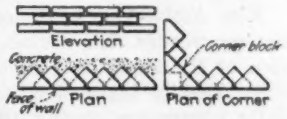
Tests conducted on the dredge Willamette, which develops a total of about 1,500 hp., showed that with the average hogged fuel then in use containing 37.76 per cent moisture and yielding 4,774 B.t.u. per lb., the dredge used an average of 9,390 lb. of fuel per hour. This fuel averaged 3,600 lb. per unit, giving a consumption of about 2.7 units per hour.

The need for making contracts for the entire hogged fuel output of mills was particularly urgent a few years ago when fuel oil went up to $2.25 per bbl., and many industries converted power plants for the use of hogged fuel, thus creating a strong demand for it. Now that oil prices have declined, hogged fuel costs may reflect the downward trend and two-year contracts of the Port of Portland, expiring next spring, will probably be renewed. The mills are on the river so that transportation is by water. The longest haul has been about 75 miles, but in summer, May to August, when water is high, the current in the river adds to time and cost of the upstream trip.

While fuel oil can be handled effectively by one small barge per dredge, it requires three to four barges for each dredge to maintain an adequate supply of hogged fuel. Seventeen barges are now used by the Port of Portland to serve the four dredges. Six of these were built within the past year at a cost of $15,000 each. The new barges have a capacity of about 240 units each, some of the older barges as low as 140 units.

Pressed Concrete Blocks for Canal Locks

TO REDUCE the cost of lock construction on the new canal between the Meuse and Wahl rivers in Holland, a facing of special concrete blocks was devised for the lock walls as a substitute for the usual basalt or vitrified brick lining, since the latter is expensive and does not bond well with the mass concrete. These concrete blocks, shown in the accompanying drawing, are about 4 in. thick and 20 in. long; they are of 1:3 gravel concrete (¼-in. gravel) and are made in forms subjected to a pressure of about 100 tons. The blocks are laid with ¾-in. mortar joints and are so stable that they serve largely as forms for the mass concrete. At corners likely to be struck by vessels a granite block facing is used. In a paper in *The Engineer*, London, it is stated by Mr. Wentholt, engineer in charge of construction, that this block lining has the advantages of hardness, cheapness and good appearance, besides eliminating expensive formwork. Thin semicircular arch blocks of similar construction were used for the roofs of the lock culverts, so that mass concrete was placed over these culverts without the use of forms. Hexagonal concrete blocks 16 in. thick also form the floor of the lock between the gates.



CONCRETE BLOCK FACING FOR LOCK WALLS

Fire Prevention in Timber Floors of Highway Bridges

Report of Co-operative Committee Finds a Definite Fire Risk and Suggests Safeguards in Construction and Maintenance

Destruction by fire of the Thirtieth St. bridge over the Allegheny River at Pittsburgh last year focused attention on the fire danger in wooden bridge floors. Numerous other serious bridge fires of the last eight or ten years were recalled and certain questions were raised concerning the nature and magnitude of this fire danger. It was suggested that creosoting introduces a special hazard, that bad design of bridge floors favors the starting or the spread of fire, that neglect in maintenance is a factor in the fire situation, that bridges should be provided with fire-fighting means, and the like. Discussion of the subject on invitation of Engineering News-Record ultimately led to the conclusion by a number of interested authorities that the subject was so important as to call for special study by a competent committee. This conclusion was warmly supported by the Wood Preservers' Association, and on the initiative of that body a co-operative committee was formed for engineering study of the subject.

The report of this committee, just issued, is reprinted in full in the following. It constitutes the first definite recognition of the fire risk in bridges, and indicates the joint responsibility of designing and maintaining authorities.—EDITOR.

DURING the past few years a number of serious fires have occurred on important bridges and the circumstances attending these fires have indicated the desirability of making a detailed study of the situation, in an attempt to bring out the important factors governing the fire hazard in timber bridge construction. With this purpose in mind a co-operative committee was formed representing fire protection, highway bridge construction, lumber, creosoting and the public interest, as given by the signatures hereto.

An extensive correspondence has been carried on with city, county and state bridge engineers, and with this and information collected from other available sources as a basis the committee submits the following report:

Fire Risk—The existence of a fire risk in bridges having wooden floors must be recognized. An indication of the importance of this risk is the fact that on some heavily traveled city bridges small fires are of daily occurrence during the summer months.[1]

The available evidence indicates that this risk is much less for country bridges than for city bridges and is greater on long bridges than on short ones.

Causes of Fires—On city bridges, fires are most commonly caused by the lodgment of lighted cigar or cigarette stubs in cracks or depressions where chaff and débris have collected. Decayed or splintered material in the floor adds greatly to the fire risk. In the case of country bridges the greatest risk is from forest and grass fires.

Other reported causes of fires are: Sparks from locomotives or steamboats; hot coals dropped by steam rollers, traction engines, tar kettles or other construction equipment; burning waste dropped by street cars; defective insulation of electric wiring, defective bonding of rails and lack of capacity in return feed wires of electric railways; fires in adjacent structures.

Relation of Preservative Treatment to Fire Risk—Creosoted material appears to be somewhat more difficult to ignite than untreated material, but once ignited it creates a fire which is hotter and more difficult to control and which is known by experience to be more destructive than fire in an untreated floor. However, decayed or partially decayed untreated wood is very easily ignited and has been the cause of many fires. The likelihood of fire is increased by treatment which results in excessive bleeding of oil, such as might be caused by the heavy treatment of green lumber. It should be noted that freshly creosoted material is much more inflammable than that in which the treatment is several months old. It is urgently recommended that orders for creosoted material be placed as far as possible in advance of construction and that the material be seasoned for three to six months after treatment.

Where it is practicable to do so, freshly treated timber may be rendered more fire resistant by thoroughly coating the upper surface with sand. The application of sand should be continued as long as there is any bleeding of oil.

Construction—In general it may be stated that tightly laid floors, in which cracks are eliminated to a large extent, are most fire-resistant.[a]

The relative fire risk of various types of floor may be stated as follows, beginning with the most fire-resistive:

(a) Wood blocks on concrete base. This type of floor may be said to have no fire risk.
(b) Wood blocks on plank sub-floor.
(c) Laminated floor of 4-in., 6-in. or 8-in. strips laid on edge and spiked together, with a bituminous wearing surface.
(d) Plank floor with bituminous wearing surface.
(e) Laminated floor without wearing surface.
(f) Multiple-thickness plank floor.
(g) Single-thickness plank floor.

Steel joists or stringers supporting floors of any of the above types reduce the risk of rapid spread of fire by reducing the amount of combustible material exposed. Where wood joists or stringers are used the fire risk will be reduced by using heavy timbers for these members. The massing of combustible material renders it less susceptible to ignition and the spread of fire and lessens the probability of serious structural damage before the fire can be controlled, in case fire-fighting means are at hand.

Special care should be exercised in the design of the floor and its supporting structure to avoid ledges or pockets in which trash may collect. The possibility of the accumulation of rubbish on truss members and in floor openings made for the passage of these members should be given careful consideration. In cases where such construction will not interfere with the proper disposal of floor drainage, curbs on timber floors should be constructed with ample clearance between curb and floor so that trash may have an opportunity to blow away.

To check the spread of fire lengthwise of the bridge the spaces between stringers, in cases where these rest on the floorbeams, should be filled with tightly fitting diaphragms over each floorbeam. Perhaps the most practicable method is to use wooden diaphragms at least six inches thick, which may be made up of two thicknesses of plank spiked together. Strips or battens should be placed around the edges of these diaphragms to cover cracks due to imperfect fitting or shrinkage.

The accompanying sketch indicates the recommended construction.

In cases where limitation of headroom is not a factor, fire curtains of sheet metal extending at least 5 ft. below the bottoms of the joists, and spaced at intervals of about 50 ft., will be of material assistance in preventing the spread of fire. The corrugated asbestos-covered metal as used for siding and roofing of buildings is suggested for this purpose.

Maintenance—Floors, ledges and pockets, and bridge seats should be kept free from street sweepings and other trash.

In the case of country bridges, particularly timber trestles, all underbrush, small timber, drift and débris, underneath and for some distance on both sides of the bridge should be removed. Grass and weeds should be cut in the early fall and drift should be removed after floods. Where the vegetable growth is heavy, chemical weed killers are recommended as being economical and efficient.

Frequent inspections should be made of any conductors of electricity which may exist on the bridge.

Floors should be kept free from splintered and decayed wood.

Provisions for Fire Fighting—For bridges where watchmen or bridge tenders are employed, water barrels, sand boxes or water mains may be employed to advantage for fighting fires. For bridges not under constant supervision the value of any of the above is questionable although sand boxes would probably be most likely to be ready for use when needed.

Water barrels and sand boxes should be covered and the surface of the water in the barrels should be covered with a light film of oil. In cold climates freezing of the water in barrels can be prevented by the addition of a suitable amount of calcium chloride.

When water mains are provided they should have hose connections every 50 ft. and hose reels every 200 ft. In cold climates they must either be protected against freezing or be kept empty with provisions for supplying them with water under pressure, either from hydrants direct or from fire engines.

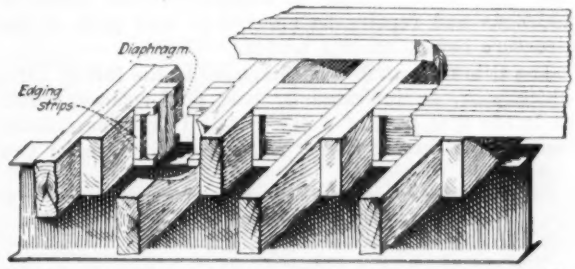
Watchmen and drawbridge tenders should be provided with at least one 2½-gal. soda-acid fire extinguisher. Where aid may be expected from a municipal fire department, there should be provided some means of transmitting alarms. If watchmen or bridge tenders are on duty, a telephone may be considered as a substitute for the more reliable and satisfactory public box on a fire alarm telegraph system.

Maintenance of the under-structure and the use of fire-fighting appliances will be facilitated by providing under the bridge floor, on each side of each pier and at intermediate points not more than 100 ft. apart, platforms constructed of fire-resistive material. Access to these platforms may be secured either by hatchways in the bridge deck or by stairs on the outside of the bridge.

In cases where fire streams from hose and nozzles are available, there should also be provided at 20-ft. intervals, both longitudinally and transversely, openings in the bridge deck to permit the use of cellar pipes, revolving nozzles or similar devices. These openings should be not less than 10 in. in diameter and should be provided with metal covers which can be easily removed but not readily displaced by accident.

Fire Retardant Paints or Treatment—The weight of the evidence, obtained from laboratories which have investigated this subject, is to the effect that, whatever may be expected from future experimentation, there is at present little that can be accomplished in the way of rendering wood fire-resistive by means of a paint coating or other treatment by chemical methods. A paint coating which is not readily combustible may, however, serve to delay slightly the time in which the lumber reaches its maximum susceptibility to ignition. The difficulty with the chemical treatment is that the chemicals will either wash out or, if waterproof, are not fire-resistive.

Conclusion—The investigation having shown that the subject of bridge fire protection is of an importance not previously recognized, the committee desires to emphasize the need for giving consideration to the fire risk in the design of highway bridges. Public officials having bridges in their charge have a clear responsibility in the matter, and the committee desires to call to the attention of such authorities the desirability of protecting bridges by due care in design and construction, by watchful maintenance, and by provision for preventing and fighting fires.



SKETCH OF FIRE-STOP DIAPHRAGMS OVER FLOORBEAMS

Chairman, GEO. W. BOOTH, Chief Engineer, National Board of Fire Underwriters, New York.
L. T. ERICSON, Chief Engineer, The Jennison-Wright Co., Toledo.
C. M. TAYLOR, Past President, American Wood Preservers' Association, Port Reading, N. J.
D. F. HOLTMAN, Construction Engineer, National Lumber Manufacturers' Association, Washington.
C. J. HOGUE, Manager, West Coast Forest Products Bureau, New York.
F. E. SCHMITT, Associate Editor, *Engineering News-Record*, New York.
Secy., E. F. KELLEY, Senior Highway Bridge Engineer, U. S. Bureau of Public Roads, Washington.

Washington, Nov. 1, 1922.

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[1]John D. Stevenson, Assistant Chief Engineer of the Department of Public Works, city of Pittsburgh, makes the following statement: "The city has several steel bridges having wooden floors. Some of these are large structures crossing the rivers and are important arteries of traffic. During the hot, dry periods of the summer, fires on these bridges are very frequent. They are of minor importance only, because we have been successful in extinguishing them before the flames have taken much of a hold. During the last summer, on one bridge fires were a daily occurrence and not infrequently two or three fires occurred in one day."

The annual report of the fire commissioners of the city of Holyoke, Mass., for 1921 states that during the year "the Department responded to 170 fires on the various bridges. The month of June was particularly prominent in this respect, when the department responded to 64 alarms for bridge fires. This epidemic was lessened in the months to follow through the efforts of the board of public works in sending the sprinkler over the county bridges frequently during the day. While the department has been very fortunate in the past in extinguishing bridge fires at a minimum loss, there is always danger of such a blaze getting so much headway as to cause the loss of one of the bridges." In practically all cases, the cause of these fires is stated in the report of the fire commissioners to be cigarette stubs.

[2]Thomas J. Wasser, State Highway Engineer of New Jersey, states that prior to January, 1922, the old Raritan River bridge at Perth Amboy was decked with closely laid rough plank flooring and that, to his knowledge, no fires were reported during the life of that floor. The deck was replanked with heavier lumber, surfaced on two sides and one edge, and laid with ¼-in. openings. Since that time there have been seven small fires on the bridge and it has been necessary for the department to put on a fire patrol to meet these conditions.

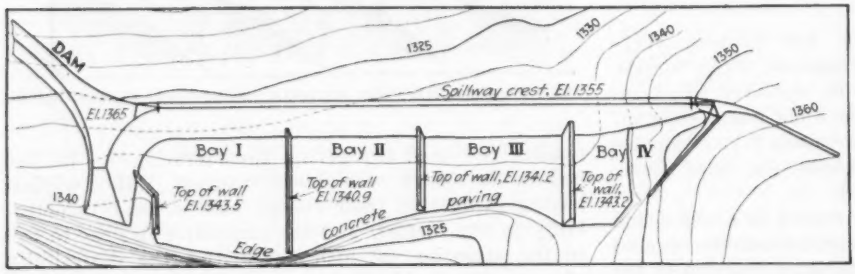
Repairing the Spillway to the Gibraltar Dam

Unexpected Floods Last Winter Tore Out Part of Concrete Spillway—Details of Repair to Water-Supply Dam for Santa Barbara, Cal.

By R. A. Hill
Quinton, Code & Hill, Consulting Engineers, Los Angeles, Cal.

During the past summer the City of Santa Barbara, Cal., has been working on the spillway at the Gibraltar Dam, repairing the damages which occurred during the last winter. Notwithstanding exaggerated reports to the contrary, there has been no real danger to the dam at any time, but the condition at the spillway was such as to render it imperative that extensive additions and repairs be effected to that part of the structure before another winter.

The Gibraltar Dam was completed in the fall of 1919, which year, as indicated by past performance, would be in the first part of a dry cycle. Long-time rainfall records also showed that it was extremely rare for two wet years to occur in succession during such a dry cycle. The normal flood stage of the Santa Ynez River is generally less than 8,000 sec.-ft. and the maximum recorded is about twice that amount. During flood years about three floods of short duration in excess of 5,000 sec.-ft. are to be expected, but the flow of the river rarely exceeds 1,000 sec.-ft. for more than 30 days in any one season.



PLAN OF GIBRALTAR SPILLWAY AFTER CONSTRUCTION, DECEMBER, 1919

Temporary Nature of First Spillway—The plans described in an article on the Gibraltar Dam and its appurtenances in *Engineering News-Record*, May 20, 1920, p. 1003, were somewhat incomplete on account of the economic exigencies. Due in a large measure to the extreme inaccessibility of the Gibraltar Dam, there has been, from the inception of the project, a certain indifference on the part of the citizens of the City of Santa Barbara. The bond issue, which was to provide funds for the construction of the dam and other units of the water system was found to be on completion of final plans somewhat less than was necessary for construction in line with the original intent. The feeling was such that it was not deemed advisable to attempt to raise an additional sum of money, and consequently, as serious floods were not to be expected for several years, it was decided to modify the spillway plans.

The original intent had been to construct an ogee weir with heavy paving to the edge of the cliff over which the water would fall 150 ft. into the gorge of the Santa Ynez River. The edge of the cliff, which is some 40 to 60 ft. distant from the spillway, is from 4 to 6 ft. higher, so that by eliminating the ogee there was formed a water cushion of approximately that depth and the concrete was reduced about 2,000 cu.yd.

The cliff near the dam is almost vertical for a considerable distance; towards the other end of the spillway, however, the slope is much less abrupt and prior to the floods was covered to a considerable depth with earth and boulders. There was such a tremendous quantity of this, that it was deemed inadvisable to excavate, as the first floods would wash away the loose material and expose the face of the cliff in far greater detail than would be possible by excavation. As it was expected that erosion would take place in several places, and particularly in a gulch which heads near the southeast end of the spillway, a sufficient quantity of cement was left on hand to allow patching to be done immediately following the first flood. Unfortunately this stock of cement was requisitioned for repair work in the Mission Tunnel and was not replaced.

Actual Effect of Flood—In spite of the fact that the storage capacity of Gibraltar Reservoir is only 16,000 acre-feet and the Santa Ynez River, above that point, drains over 200 square miles, there was no overflow during the winters of 1919-20 and 1920-21. A violent storm, however, occurred in December, 1921, which centered in Southern California and in less than a week an average of 8 in. of rain, one-half of the total mean annual, fell on the coast cities and a much greater amount on the mountains. During this storm the reservoir filled completely and overflowed the spillway with a maximum discharge of about 3,500 sec.-ft. In the month of January several small floods occurred, so that even with the waste gates open, there was water over the spillway most of the time. The temperatures during this month were quite low, and snow accumulated to a considerable depth on the mountains, with the result that, following a warm rain in February, a flood of 6,500 sec.-ft. maximum poured over the already damaged spillway apron. Since that date the rains have been moderate and there have been no floods of magnitude.

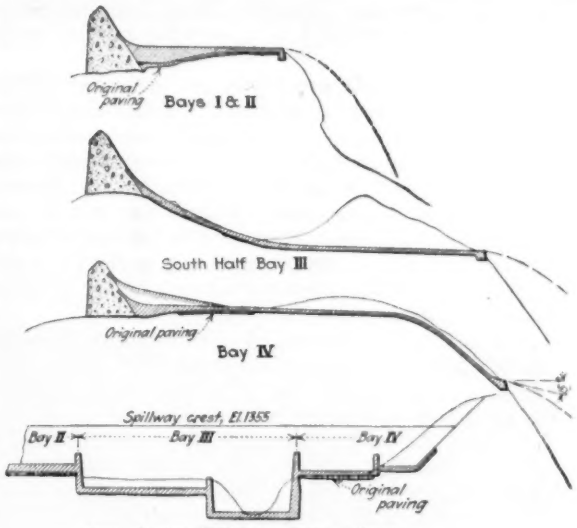
After the flood in December, it was found that the northwest half of the spillway was not damaged, and that the rock below was quite favorable, but at the end away from the dam a rather unfavorable condition was exposed. The gulch was seen to have followed approximately the line of fault, running in a generally east and west direction, which crosses the axis of the spillway about 70 ft. from the south end. As this axis is approximately northwest and southeast, it is seen that a large portion of the water discharging over the spillway naturally concentrated along this fault

line. Erosion near the head of the gulch and of the paving in the third bay from the dam had been quite severe. The abutment of the spillway was of the same type of sandstone as the abutment of the dam itself but overlying a portion of the hard rock in that part of the spillway just north of the fault plane there was found a thin stratum of material which had disintegrated somewhat under the action of water. The paving over the faulted zone at the toe of the spillway weir in the third bay had been broken and torn up by the action of the falling water, until a hole about 20 ft. in its greatest diameter and 6 ft. in depth was formed. There remained only about 10 ft. of badly shattered rocks between the edge of the hole and the face of the cliff.

The flood of February, 1922, poured over the spillway 3½ ft. in depth and plunged down upon the already damaged paving, and broke through this intervening material, cutting a notch in the face of the cliff. While the entire discharge of this bay was concentrated in a narrow chute, the greatest erosion took place beyond the end of the original paving. At that point a hole approximately 30 ft. square and 20 ft. in depth was formed by the combined action of all the water discharged over the left half of the spillway. This left a chute about 20 ft. wide sloping uniformly from the toe of the weir to the bottom of the hole some 30 ft. beyond. At some time during this flood about 20 ft. of the division wall between the third and last bays broke off and dropped into this hole. With the exception of a small piece of paving in the last bay, all of the damage was restricted to this one locality.

Had this serious break not occurred in the paving between the spillway weir and the edge of the cliff, the effect of these floods would have been advantageous as all the earth and boulders were washed off and the geologic conditions completely exposed. On the other hand if there had been no damage, it is doubtful whether sufficient interest could have been aroused in Santa Barbara to have made it possible to finance the completion of the spillway.

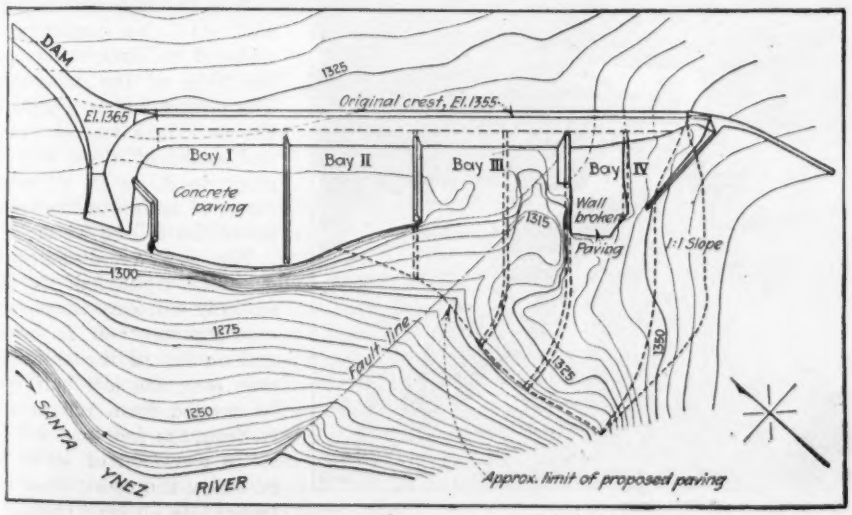
Probable Cause of Damage—There were, apparently, several contributing and dependent causes, some of which might have been avoided, and some, under the economic restrictions, unavoidable. At some stage of



TYPICAL CROSS-SECTIONS OF REPAIRED SPILLWAY

overflow the water cushion apparently did not function, a standing wave was formed, and the full force of the impact of the falling sheet came on the paving along the weir. This condition is known to have prevailed at 3 ft. overflow where the water cushion was approximately 6 ft. in depth. This factor alone was not sufficient to have caused material damage, for otherwise the paving would have been torn up along a greater length of the spillway, and erosion of the rock beneath would have taken place.

The modified plans for the spillway called for paving 1 ft. in thickness to be laid directly on solid rock, with the exception that in the case of knobs which projected above the general plane of bedrock, a minimum thickness of 6 in. was allowed. The paving was poured last, and at the point where damage has occurred some of the contractor's plant had to be moved to allow for its completion. At this particular spot, in spite of the fact that the balance of the construction is uniformly of excellent character, the visible condition showed that the construction was faulty, and inherently weak. The paving was in few places more than 6 in. in thickness and knobs of rock actually protruded at many points. There was positive evidence that the paving was laid on a loose rock backfill along the toe of the weir in the damaged portion. The heavy impact of the water dropping twenty or more feet, together with the blows delivered by floating debris quite naturally broke this thin layer of concrete and exposed the loose material. This backfill probably washed out almost immediately, following which great slabs of the floor were lifted up by the force of the sheet of water driving beneath it. The division wall between the last two bays was not carried as far out as intended, with the result



TOPOGRAPHY AFTER 1922 FLOOD, SHOWING REPAIRS

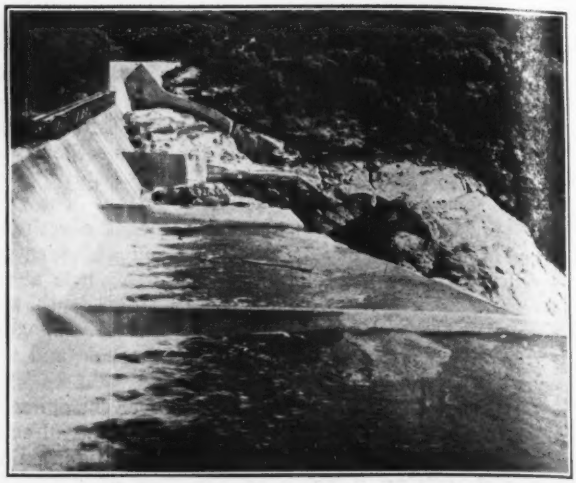
that a greater part of the flow of the last bay concentrated in the gulch which is immediately in front of the third bay.

Even these conditions would not have resulted in serious damage had it not been for the unfortunate fact that the location of the only poor construction coincided exactly with that of the shattered fault zone. The rock on both sides of the plane of the fault is badly cracked so that after erosion was started this rock came out in blocks. The large hole described above is a result of this action rather than a product of scour, as indicated by the jagged character of the rock exposed on its almost vertical sides.

It was this combination of circumstances, first, the failure of the water cushion to act as such; second, the faulty construction work at this point; and third, the shattered strata along the hitherto unknown fault line, which together have brought about a condition demanding immediate and comprehensive repairs and additions to the temporary spillway at the Gibraltar Dam.

Reconstruction Work—The plans being executed are similar to the original, except that the erosion near the end away from the dam has necessitated certain modifications and additions. The two bays comprising the north half of the spillway are practically undamaged by the floods and such work as is done here will be largely substitution of permanent for temporary construction. The edge of the cliff is from 5 to 6 ft. higher than the toe of the weir and from 50 to 60 ft. distant. This wedge will be solidly filled with concrete and joined by a smooth curve to the downstream slope of the weir.

The third bay, that is the damaged one, was 70 ft. in width but now must be divided into two parts in order to avoid an excessive amount of either concrete or excavation. The 45-ft. closest to the dam is not eroded materially, but the paving is broken up entirely and the underlying rocks to a depth of about 4 ft. are of poor character, so that both of these must be removed. The ogee form will be used here, as in the case of the two north bays, but owing to the excavation the level of the paving will he from 4 to 6 ft. lower, the paving in this bay will be extended on down the slope of the cliff for a distance of some 70 ft. to prevent erosion at the head of the fault crevasse. This slope paving will be continued to the north, but gradually reduced in width to taper out finally opposite the center of the second bay from the dam.

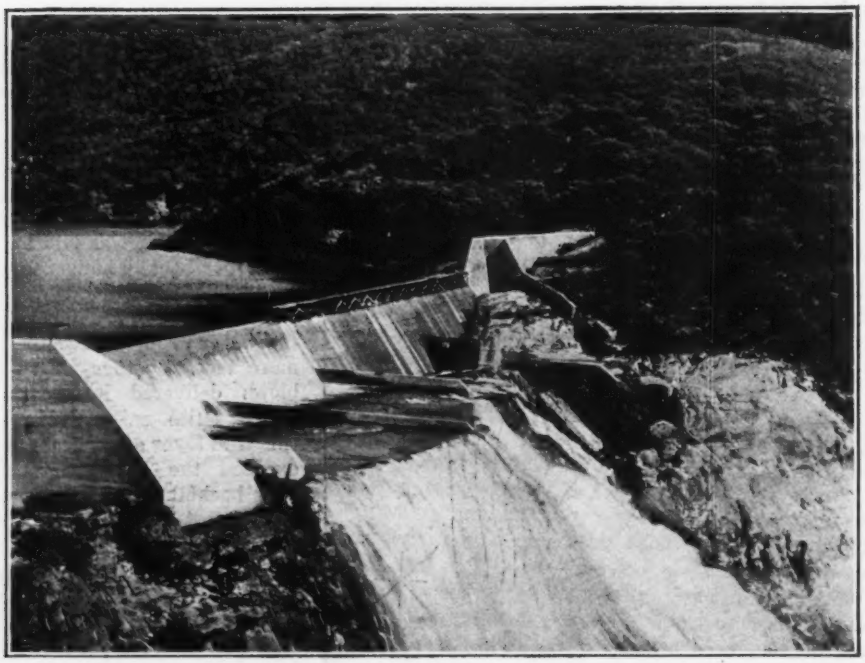


CLOSE VIEW OF DAMAGED SPILLWAY

The other 25 ft. of the third bay has been eroded below the level of the soft upper layers so that the chute now formed will be paved and joined by a curve to the spillway weir. The opposite wall of the hole torn out by the February flood will be shot away and this chute will be carried beyond so that water discharging through it will not concentrate along the fault.

In the bay next to the mountain the new construction follows closely the original intent. Some of the paving near the toe of the weir has been torn out but the general character of the material beneath was such that but little erosion occurred. The outlet channel of this bay is being carried out approximately 140 ft. from the weir and will be considerably widened by excavation into the side of the mountain. The paving will be joined to the weir in a smooth curve and sufficient slope will be given to it, as in all other cases, to maintain the velocity of the falling water.

The water discharging over the right half of the spillway will leave the paving approximately 60 ft. away and on top of the cliff, but that over the left half will be carried from 100 to 140 ft. from the weir and will be at an elevation of 40 to 50 ft. below the crest when released. In all cases the angle

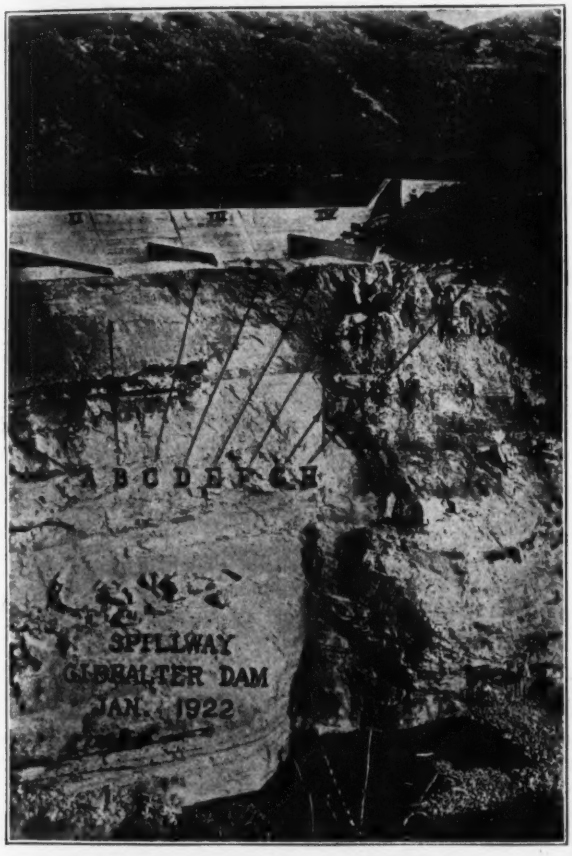


LOOKING AT DAM FROM CLIFF ACROSS RIVER

of discharge will cause the water to jump 50 to 100 ft. beyond the paving before it strikes the face of the cliff. Because free discharge into air cannot be secured, the work will be constructed so as to prevent the formation of a standing wave on the paving. In addition training walls are provided between channels of different elevation.

Summary.—It is estimated that there will be required about 3,200 cu.yd. of concrete and 3,500 cu.yd. of rock excavation. Their cost is estimated at $90,000.

Danger to the major structure, the dam, does not exist, nor could any possible failure of the spillway cause the catastrophe feared by some people unfamiliar with the conditions. In all fairness it should be stated that



GIBRALTAR SPILLWAY FROM CLIFF ACROSS RIVER

(A) Material under overhang not washed out. (B) Hard cap, same as abutment of dam. (C) Thin stratum of soft material. (D) Portion of paving which failed in December, 1921. (E) Location of notch cut in face of cliff by February, 1922, flood. (F) Location of hole formed by February flood. (G) Fault line exposed by floods. (H) Approximate end of proposed chute in Bay 4.

had the fault zone been visible, it is probable that a heavier type of construction would have been insisted upon and would have been allowed.

Quinton, Code and Hill of Los Angeles were consulting engineers to the City of Santa Barbara during the period of construction and are now retained as consulting and supervising engineers in all matters pertaining to the repair of the Gibraltar spillway. All construction work at the dam and on the various units of the aqueduct was under the supervision of E. E. Haskell. The Gibraltar Dam and its appurtenances was contracted to W. A. Kraner of San Francisco, associated with Bent Brothers of Los Angeles.

Rock-and-Wire Deflectors Protect Banks Against Floods

THE California highway commission last winter constructed about 2,000 lin.ft. of diversion walls made of rock laid in wire mesh casings. These structures, known to engineers of the highway commission, as "sausages," are found to afford the desired bank protection at a comparatively low cost. All the work was done near Los Angeles where stream beds which are dry

"SAUSAGES" READY FOR SERVICE ON BIG TEJUNGA CHANNEL

Rich orchard land at the right was rapidly being cut away by flood currents that undermined the toe of the steep banks.

for most of the year, occasionally carry capacity floods that rapidly cut their banks, endangering highways and even carrying away improved land.

The "sausages" are made by unrolling side by side where the structure is to be built two widths of No. 6 gage, 6-in., electrically welded wire mesh, and firmly lacing the adjoining edges together with No. 12 galvanized wire. Rock of any size over 6 in. in diameter that can be conveniently handled are then brought on horse-drawn sleds and piled by hand along the center of the wire mesh. When the pile has reached a suitable height the outer edges of the strips are brought together on top and laced with No. 12 galvanized wire.

Two sizes of "sausages" have thus far been built in about equal quantities, the smaller about 10 ft. and the larger 14 ft. in circumference at a cost of about $1.50 per lin.ft. for the smaller and $2 for the larger. The former are made with two 5-ft. strips and the latter with two 7-ft. strips of the wire mesh.

Wing walls made in this way are anchored only by their own weight. They begin at the bank to be protected and extend downstream and out into the channel. In times of flood they tend to collect debris that further increases their current deflecting effect.

LAST CONSTRUCTION STAGE—LACING THE WIRE MESH

Rocks are hauled to the pile on sleds from both sides. Very large rocks are used on the bottom of the pile where possible.

FROM JOB AND OFFICE

Hints That Cut Costs and Time *For the Contractor and the Engineer*

Massive Construction in Anchorages and Towers Features Columbus Bridge

By R. C. CHENEY
Assistant City Engineer, Columbus, Ohio

THE CITY of Columbus, Ohio, has but recently completed a short span suspension footbridge connecting two park areas, which is unusual in foundation work for towers and in the construction of its cable anchorages. High water a year ago took out a light cable span which was the only means of crossing Alum Creek in the eastern part of the city for a distance of about three-quarters of a mile. Replacement of this bridge was necessary, so the type herein described and illustrated was constructed.

TOWER AND APPROACH RAMP
Massive towers formed one of the features of the suspension footbridge connecting two park areas in Columbus, Ohio. The total height of towers including foundations is 43 ft., only 17 ft. of which is above floor grade.

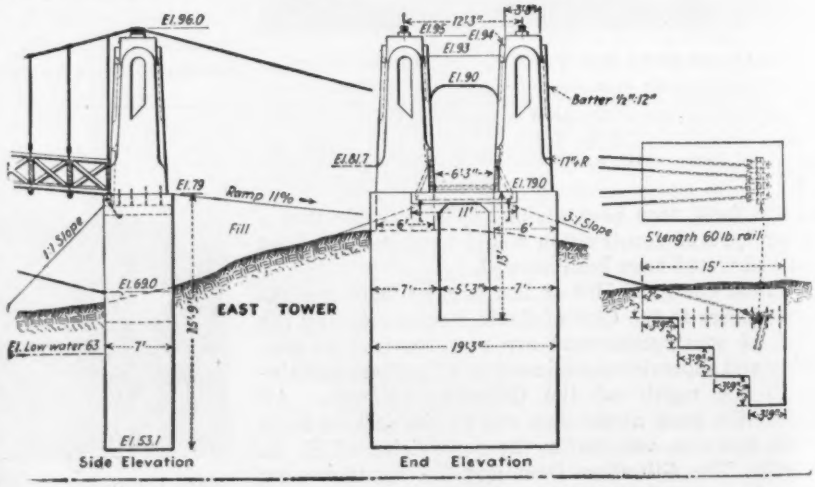
The stream at the bridge site normally flows about 8 ft. above low water, but often overflows several times a year flooding the flat ground on the west bank, the east bank being protected by a 6-ft. levee. A bridge floor grade of about 12 ft. above the general park grade was established, necessitating construction of embankment approaches at each end which were graded and seeded. A 6-ft. limestone walk was also built winding down these ramps.

At first it was believed that foundation soil would be of low bearing power and the plans contemplated wood piles under the towers. Upon excavation, however, gravel was found. Though satisfactory for bearing power alone, it was feared this gravel might be scoured because of the location of the towers with respect to the stream. Sufficient penetration with wood piles was impossible. Test piles and steel rods in each hole indicated rock or a firm resistance at 8 to 9 ft. below the planned bottom.

Encasing the footing with steel sheet piling was considered, but this was disregarded in favor of carrying the concrete footing down. The excavation was therefore continued and about 5 ft. below the planned grade a bed of blue clay was encountered, which was very firm and difficult to excavate. The towers were therefore concreted in pockets 3 ft. deep into this material, making the total height of the towers including the foundations 43 ft. Of this distance 17 ft. only was above floor grade.

The anchorages were constructed early so that the concrete after having set sufficiently was able to carry the cable load during the bridge erection. In constructing these anchorages the concrete was first brought up to a plane within 3 ft. of the finished grade. The rails were embedded for attaching the closed bridge socket, and the cables were hooked at the ends to these rails and elevated to the tower saddles. When the bridge floor was assembled and adjusted to grade the upper lift of the anchorage was concreted, encasing permanently the attachment of the cables. As the top grade of the anchorages was about the general ground elevation, a thin covering of earth was spread over and seeded with the other surface. Concrete in the tower footings and anchorages was 1:3:6 and all other concrete 1:2:4.

DETAIL OF HANGER AND TIGHTENING TIE
The lower rod used as a tightening tie for the rail system projects far enough up to connect through a small block with the hanger rod. The block allows the upper rod to be screwed up or down for local vertical adjustment.



TOWER ELEVATIONS AND ANCHORAGE DETAILS
Anchorages were constructed early enough to support the cable load during the erection of the bridge.

CABLE ANCHORAGES FOR COLUMBUS BRIDGE

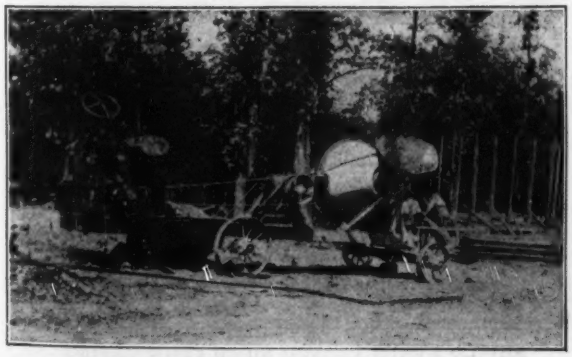
Concrete was poured to within 3 ft. of the finished grade, the cables hooked to the rails and elevated to the tower saddles. When the bridge floor was adjusted to grade, the upper lift of the anchorage concrete was poured.

The bridge was built by the city of Columbus, R. H. Simpson city engineer. The construction was under the direction of the division which handles bridges and other structures, of which the writer is engineer in charge, and J. F. Evans resident engineer. The Capital Construction Co. of Columbus, the contractor, handled the superstructure, and the Grant-Boulton Co., subcontracted the substructure.

Dismantled Touring Car Supplies Motive Power to Drive Mixer

THE photograph below shows a concrete mixer driven by a gasoline engine taken from a Ford touring car. The mixer was usually driven by an electric motor but in some emergency development work no motive power seemed at hand. A Ford touring car was temporarily dismantled and the engine, hood, instrument board, and storage battery were attached to two channel irons. A short shaft, mounted on bearings between the channel iron frame and carrying a pulley, was attached to the engine propellor shaft beyond the clutch. The speed of the small drive pulley was 1,025 r.p.m. when the touring car was rated at 15 miles per hour.

Over 200 cu.yd. of concrete were mixed with this machine which worked quite as well as when driven by an electric motor.



FORD ENGINE REPLACES ELECTRIC MOTOR ON MIXER

Pile Cutoff Saw Is Mounted on Carriage Extending from Piledriver Scow

IN THE construction of Section 1 of the Jersey—Maryland Street dock wall in the harbor at Buffalo N. Y. a method for cutting off piles under water was designed by the contractor which has rather unusual features. The total length of this section of the dock was 546 ft. and consists of wood piling driven to rock and surmounted by rows of premolded concrete blocks with a reinforced-concrete slab 20 ft. wide on top of and between the blocks. There are 49 bents, each bent having two rows of piles spaced 2 ft. 6 in. on centers and each row consisting of seven piles, making a total of 686 piles. The method of procedure in cutting off piles was as follows:

A track consisting of two 8-in. I-beams was extended out from the piledriver, one end being bolted in place on the deck of the driver and the other end being held in place by two guy cables attached to the piledriver leads. A constant check was kept by means of a carpenter's hand level on the track. A carriage with four small flanged wheels and an A-frame supported the shafts for the saw and a gasoline motor and was operated back and forth on the track by means of a small cable and hand winch. The shaft was held in place in the A-frame by two sets of guys and was raised or lowered with a chain block which was fastened on top of the A-frame. The saw was belt-driven by the gasoline motor. The piledriver was held stationary by means of a 12 x 12-in. spud placed in the leads. This spud leveled the track of the saw carriage by leveling the boat itself.

PILE CUTOFF SAW USED IN BUFFALO HARBOR WORK

The track on which the cutoff saw carriage operates is kept level by adjusting the spud in the piledriver leads. The device is controlled from the piledriver by a hand winch. Cutoff elevation is established by raising or lowering the saw by means of a chain block, the proper elevation being secured by sighting on a target in the A-frame shaft.

A target was placed on the guy supporting the shaft in the A-frame at a given distance from the bottom of the saw. This target was then set by an observer on shore with a level and raised or lowered by means of the chain block. At a given signal the saw was set in motion.

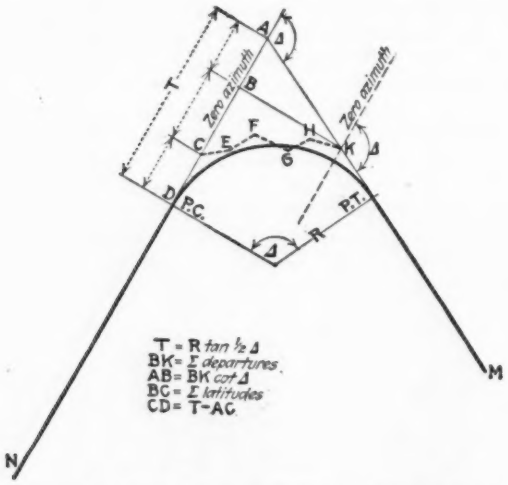
The work was done under the direction of George H. Norton, city engineer, and John T. Mockler, assistant engineer. George Parks Sons Co., Inc., Buffalo, N. Y., was the contractor.

Locating a Curve With an Inaccessible P.I. In Thorn-Brush Country

By W. W. Armstrong
Cadiz, Ohio

IN LOCATING a curve recently the point of intersection was in a deep gorge and the ground where the curve was to be located was covered with thorn brush, so the following method was used:

In the accompanying sketch, *DA* was assumed to have a zero azimuth. With a transit having a full



CURVE RUN IN FROM PRELIMINARY TRAVERSE

With an inaccessible point of intersection the above curve was located as shown, so that little thorn brush, which covered the site, had to be cut out of the way to allow instrument work to proceed.

circle limb in a clockwise direction a traverse by the back angle method was picked out through the openings in the brush along the line *CEFGHK*. With the instrument set at *K*, oriented and the telescope directed toward *M*, the vernier reading or azimuth of the line *KM* is equal to the central angle of the curve. For convenience the direction *DA* was called north. Then the algebraic sum of the latitudes is equal to the line *BK*, and the departures the line *BC*. *AB* is equal to *BK* cot Δ. We then measured back to *D* from *C* and located the P.C., from which the curve was run. It was much easier then to clear the brush ahead of the chainmen.

Simple Method of Making Prints

By Frederic I. Winslow
Consulting Engineer, Framingham, Mass.

I VENTURE to suggest a trivial, yet convenient method of securing a clear blue or black print from a typewritten sheet; which I have never seen published. The copy is written on a thin sheet of white paper inserted in the typewriting machine, but the paper is backed with a carbon sheet with the carbon side against the back of the white paper, and not placed as is done when a number of carbon copies are made. The keys are struck as hard as is practicable, making an impression of each letter on the back of the paper. If done thus, a clear print is secured at an inexpensive figure and with a minimum of effort.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Steel Shield Pulled by Excavator Keeps Trench from Caving

By P. H. Knight
City Engineer, Frankfort, Ind.

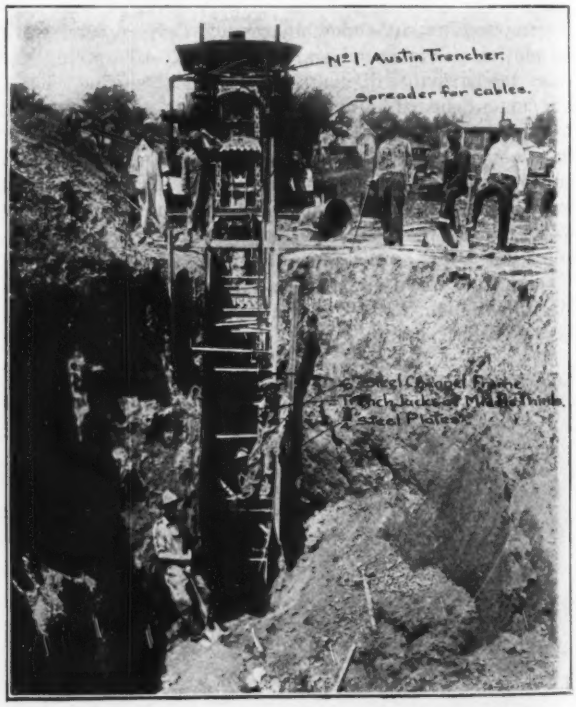
A SHIELD has been used in the construction of a district sanitary sewer 7,500 ft. long and 18 in. in diameter at Frankfort, Ind.

An Austin trench excavator was digging the trench and as the soil was sandy loam much trouble was caused by the banks caving to the outside line of the tractions. The sides of the trench held to a depth of about 4 ft., but owing to the boom and bucket it was impossible to prevent caving from there down to the pipe. This made a dangerous situation for the bottom men and the shield was designed to protect them. The depth of the trench where the shield was erected was 17 ft.

The shield is simply a ¼-in. steel plate about 18 ft. long set up on edge at each side of the bottom of the trench to a height of 12 ft. A channel iron frame was built at the front end, and another frame 3 ft. from the rear end. Vertical strips of wood were bolted to the steel sheets at 5 and 10 ft. from the front end.

A wire screen was fastened to the front end of the shield to prevent the stones (which sometimes roll down on the boom and buckets) from hitting the men.

The front end of the shield at the channel iron frame was hooked near the top to two ¾-in. steel cables. These cables were carried up and crossed before hooking them to a steel beam spreader at the top of the trench. Other cables, spaced wider apart, then carried the strain ahead to the excavator. The spreader was on wheels. The shield moves ahead at the same rate as the excavator.



SHIELD KEEPS TRENCH SIDES FROM CAVING

FROM JOB AND OFFICE

For Contractor and Engineer

Wrongly Devised Details That Cut the Contractor's Profit

By Frank B. Lee
Philadelphia, Pa.

IN INSPECTING certain construction jobs in Philadelphia my attention has been directed to a number of badly-devised details both in plant layout and in the operation and use of equipment. In the following paragraphs several examples are cited wherein money was lost or work complicated through more or less bunglesome methods.

In a certain cellar excavation the runway for trucks handling excavated material was started diagonally across the site to be excavated in order that the trucks might turn in a narrow alley. If the runway had been placed in the center of the work and the runway flared at the top all excavation could have been done by mechanical means and the trucks would have been given room enough at least in which to start the turn into the alley. By the method used a corner of the site was left which had to be excavated by hand. (Fig. 1.)

On another job excavation that could have been done entirely with mechanical means had to be done by hand because sheeting was not driven in advance of the excavation. Then, too, the method of driving the sheeting was rude. This job was on an excavation for the basement of an office building. Three-inch by 10-in. sheeting was driven with wooden hand mauls. The mauls even lacked iron reinforcement bands. When the men were driving the sheeting the shovelers below stopped work, and everyone stopped when the teams

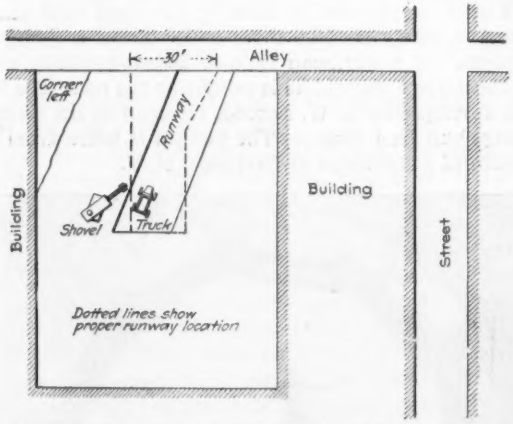


FIG. 1—LOCATING A RUNWAY POORLY AND WELL

hauling dump wagons were being unhitched from empties and hitched to loaded wagons.

Another bad feature of this job was the method in which teams and load were hauled up the runway. (See Fig. 2). They were hauled up by a hoist but with the hoist line attached to the side of the wagon at the front. When the wagon was pulled up the incline the hoist line interfered with the teams to such an extent that the driver had difficulty in guiding the wagon. Why not hitch at the rear of the wagon with an offset

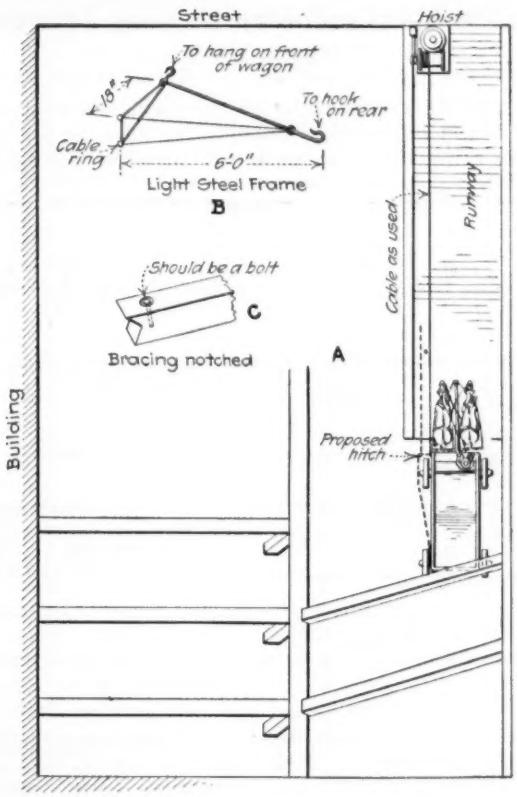


FIG. 2—TWO ERRORS IN BASEMENT EXCAVATING

brace hung in front so that the hoist line would clear the team? (See Fig. 2,B.)

Still another piece of rough work on this same job was noticed in the manner in which the timbering supporting the excavation was framed. As is shown in Fig. 2 the diagonal timbers were notched, but no safeguard was provided against their splitting. Bolts should have been run through the timbers. (Fig. 2,C.)

A certain road job should have shown a profit to the contractor who had it but through improper and inadequate use of equipment and through improper material handling, it was built at a loss. Stone was taken from a quarry near the job and on a direct line from the job to the railroad siding where other concreting materials were received. In actual work the material was all dumped on boards ahead of the mixer and then transported to the mixer in dump carts. Considerable saving would have been effected, in my belief, if all materials had been concentrated at the stone bin and then loaded into batch boxes to be dumped directly into the mixer skip with no costly rehandling.

Another cellar excavation job which attracted my attention was one on which material was excavated by hand from pier foundation sites, then rehandled into dump wagons and hauled 70 ft. to be dumped onto a fill. One fresno scraper would have done the trick with all costly handling and loading charges eliminated.

The things I mention here are small but they are costly. They seem due not to a lack of knowledge but to indifference where refinements in methods are concerned. It is easy to keep in touch with the latest uses to which machinery can be put. There is no excuse for such rough construction work.

Slide Rule for Solving Manning Formula

By T. Kiang
Assistant Engineer, Chihli River Commission, Tientsin, China

MANNING'S formula for the calculation of flow in open channels is generally regarded as the simplest of its kind in common use. Diagrams for solving formula with a view to avoid laborious computations have been devised. The writer finds a still quicker method that is a special slide rule. The annexed figure shows such a slide rule in two parts. Part A, when folded along the heavier lines and pasted with the shaded portion between those two scales cut out, will form an envelope which corresponds to the fixed part of a common slide rule. Part B, when folded along the middle line and pasted, forms a slide which will fit and slide in the envelope formed from Part A. With the scale of r on the slide opposite that of v on the envelope they will work together like a common slide rule.

Example: Given $n = 0.020$; $r = 1$ ft.; and $S = 1 \div 5{,}000$ or 0.0002. To find value of v.

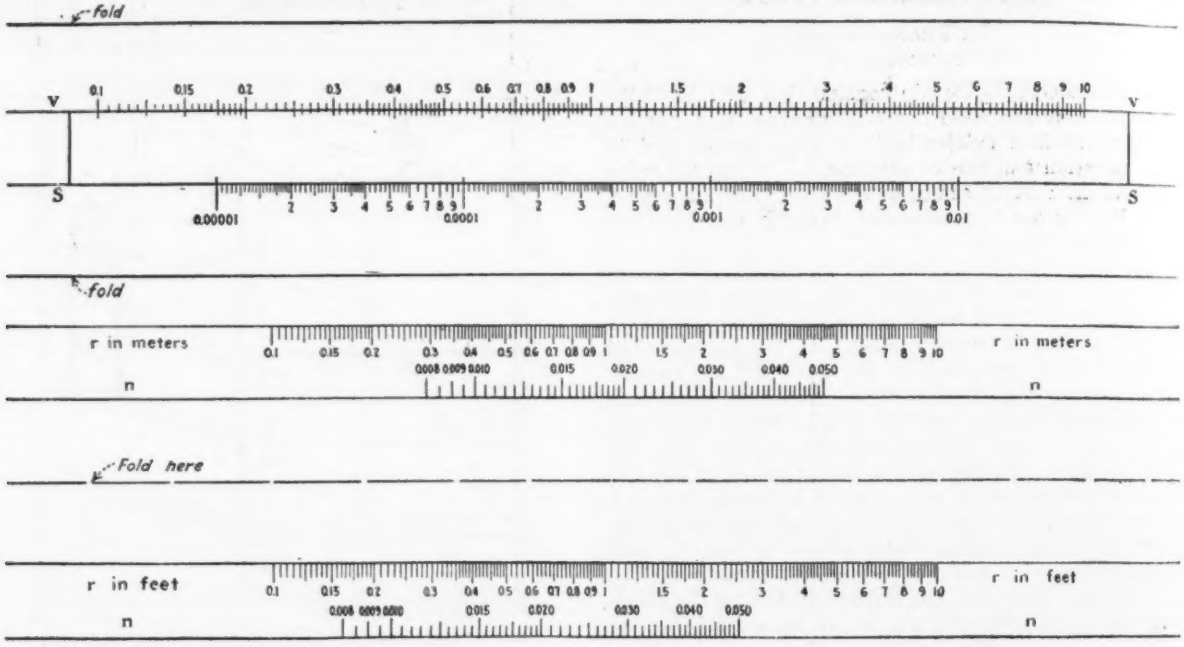
Solution: Using the English units side, move the slide until the line of 0.020 on the n scale coincides with the line of 0.0002 on the S scale. Opposite the line of 1.0 on the r scale is found the line of 1.05 on the v scale which represents the value of v required; i.e., $v = 1.05$ sec.-feet.

With any three quantities given the problem can thus be solved. When the dimensions are in metric units, use the other side of the slide to find v.

All graduations are in their logarithmic values and can be made to cover any given range so far as the lengths of base of their logarithms bear a certain relation to each other as is necessary to satisfy the original equation. This relation can be expressed as follows:

Combination A: With length of base of logarithms of scale r equal to $\frac{2}{3}$ of that of scale v and that of scale S equal to $\frac{1}{2}$ of that of scale n.

Combination B: With length of base of logarithms of scale S equal to $\frac{1}{2}$ of that of scale v and that of scale r equal to $\frac{3}{4}$ of that of scale n. Note that lengths of base of logarithms of scales n and v are not necessarily equal.



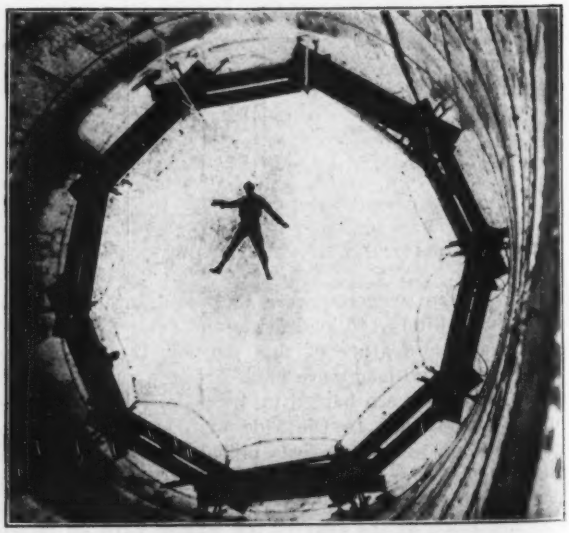
SLIDE RULE FOR SOLVING MANNING FORMULA

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Use Circus Safety Net in Tank Erection

ATTACHED to the brackets holding up the scaffolds used by riveters in erecting the steel tank shown here is a safety net like those under circus trapeze performers. If a workman falls or absent-mindedly steps off the narrow scaffold he is caught by the net. The idea was developed by C. W. Penrod, foreman in the Chicago Bridge and Iron Works. The picture is taken from the bottom of a standpipe at Carthage, N. Y.



SAFETY NET TO SAVE TANK RIVETERS

FROM JOB AND OFFICE

For Contractor and Engineer

Truck Outfit for Painting Pavement Center Lines

By Edward N. Hines
Chairman, Wayne County Road Commission, Detroit, Mich.

A TRUCK-MOUNTED outfit for marking the center lines of concrete pavements has greatly reduced the labor cost, in Wayne County, Michigan, of this very important safety measure. When the practice was first begun it took four painters a day to stencil a mile of road, making the labor cost alone about $25. With the painting machine, two men are marking from 6 to 7 miles of pavement every day.

TRAILING WHEEL ON TRUCK MARKS PAVEMENT
An iron frame, following the truck, supports a wooden wheel having a 1-in. felt covering. Paint, played upon the felt tread by compressed air, is transmitted to the pavement by the trailing wheel.

In the outfit illustrated a DeVilbiss compressed-air painting machine has been mounted upon a Ford truck. Following the Ford truck is an iron frame upon which has been mounted a wooden wheel about 2 ft. in diameter and 4 in. wide. This wooden wheel follows in the track of the left-hand wheels of the truck. Around it is tacked about 1 in. of felt. As the truck is driven down the road the trailing wheel revolves upon the pavement. A spray of paint is played directly on the felt tread about 1 ft. above the pavement. This paint is immediately transferred to the pavement by the felt. When it is desired to run without painting, the iron frame and wheel can be raised and laid over on the back end of the truck.

To guide the driver in centering the line, the center of the road is marked about every 50 ft. in front of the truck with a piece of chalk. In case it is desired to re-mark a line, which has grown faint, the driver follows directly with his left-hand wheel over the old line.

A white paint line is being used instead of a black tar line because much of the old concrete mileage has become so darkened from oil drippings that a black line cannot be easily followed at night.

Water Level in Deep Well Discovered by Simple Electrical Device

By Jent G. Thorne
Consulting Engineer, Clinton, Iowa

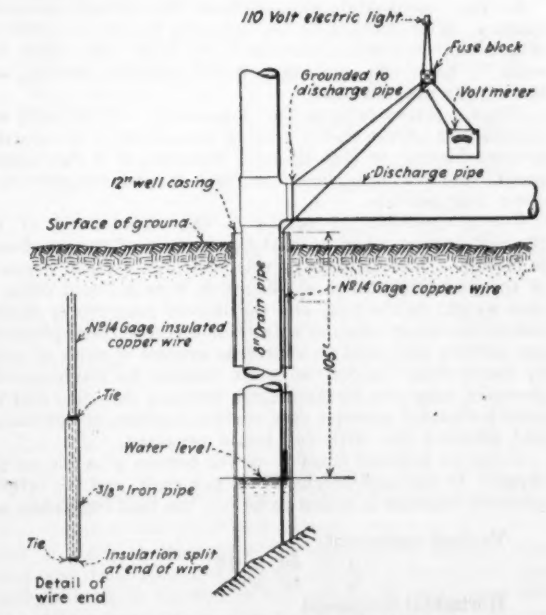
DURING the testing of a new deep well recently drilled in De Witt, Iowa, the height of the water in the well, both before pumping and while pumping, was measured by means of an electric current.

To a 14-gage, rubber-insulated copper wire was attached securely a $\frac{3}{8}$-in. iron pipe 2 ft. long, to act as a weight. The wire was cut off about an inch below the end of this pipe and the insulation allowed to extend slightly below the end of the copper wire. The other end of this wire was connected to one terminal of a fuse block, and a second wire was run from the second terminal on the fuse block, and grounded on the iron drop pipe. From the third and fourth terminals of the fuse block a connection was made to the 110-v. city electric current. A voltmeter was connected to the first two terminals of the fuse block to indicate when the circuit was made.

While the wire was being lowered into the well the hand on the voltmeter stood at zero until the water was reached, when it would move up four or five points. By working the wire up and down several times the exact point was indicated where the hand on the voltmeter would commence to move. In this way the exact height of the water in the well was measured very quickly.

A string with a wooden float was used but was not successful on account of the lack of space between the drop pipe and the well casing. An electric bulb was tried instead of the voltmeter but did not give results.

The whole apparatus is very simple and easy to install and gives the results accurately.



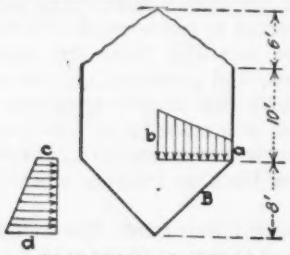
DEVICE FOR ASCERTAINING WATER LEVEL IN WELL
One wire extended from a terminal on a fuse block into the well, and a second wire was grounded on the iron drop pipe. Completion of the circuit (when the wire in the well touched water) was shown on a voltmeter. By measuring the wire length at that point where a completion of the circuit was recorded, the water level was ascertained.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Coal Bin Pressures

Sir—In the communication by Jacob Feld, Oct. 19, 1922, p. 669, on coal-bin pressures, the categorical rejection of the equivalent fluid pressure method is not convincing. To say that a method of designing for lateral pressure of coal is theoretically unsound does not convey anything, and to say that it has been experimentally proved incorrect is equally devoid of meaning, particularly when the reader is given no hint as to who made the experiments, and when and how.



COAL BIN ANALYSIS BY LIQUID PRESSURE METHOD

Small diagrams *ab* and *cd* give the vertical and horizontal components of load on inclined beam *B*.

If there is one thing that experiments and experience have proved to be impossible it is to find even the approximate pressure of a granular mass such as coal. Coal can be made to stand against a vertical surface by setting up a few slender boards propped with clothes props; if the boards be taken away it may stand alone and it may come down like an avalanche. Everyone will admit that the avalanche possibility is the one that should be provided against in design. Sound theory may account for these three conditions, but it has only academic and school-room interest. The facts are these:

1. Coal may exert a lateral pressure equal to that which a liquid would exert, and designs must be made for this contingency.

2. For horizontal top surface the lateral pressure exerted, as determined by the ordinary theory of pressures of granular materials, can be found with very much less work by using the equivalent liquid pressure method, and the results are identical.

When a theory tells us that a pressure is many tons and when a test proves that it may be zero, there is no occasion to burn incense to that theory. However, if it furnishes a rough rule for safe designing, use it, and simplify it in every way possible.

For a condition of surcharge the added head of the "liquid" can be taken as half the amount of the surcharge in the bin. Designs made on this basis, the vertical pressure of the coal being taken as though it were a liquid equal in unit weight to the coal and the lateral pressure or lateral component being taken as a fraction of the vertical pressure, are entirely safe, and an enormous amount of work is saved by the method. To determine the fraction for the horizontal pressure, take any of the lateral pressure theories, find the total horizontal pressure on a vertical surface, no surcharge, and compare this with full liquid pressure.

Given an inclined beam *B* on the bottom of a bin as per sketch: If the coal weighs 50 lb. per cu.ft. and the lateral-pressure fraction is found to be 0.3, the load intensities are

Vertical component

$$a = 50 \times 10$$
$$b = 50 \times 24$$

Horizontal component

$$c = 0.3 \times 50 \times 13$$
$$d = 0.3 \times 50 \times 21$$

The bending moment on beam *B* is very simply determined from these data.

EDWARD GODFREY.

Pittsburgh, Oct. 21.

Steep Street Grades in San Francisco

Sir—The article "Brick Used in Paving 34 per cent Grade" in *Engineering News-Record*, Aug. 17, 1922, p. 267 concludes by saying, "The writer has seen and heard of several paved streets with grades as high as 30 per cent, but to his knowledge this street is the steepest one of which there is any knowledge."

We have in San Francisco a short stretch of cobble pavement laid on a 50.1 per cent grade on Duncan St., between Noe and Sanchez streets. Although this street may not be known to eastern engineers, it is well known on the Pacific Coast, especially to automobile dealers, who have frequently sent their cars over the grade to test their stamina. This particular pavement is 40 ft. wide. Granite curbs and 2.17-ft. basalt block gutters, cement grouted, laid on a concrete base, adjoin the cobblestone pavement. This street was paved to the existing grade, which the property owners did not want changed. The pavement protects the hillside from undue erosion, and has no other practical value.

On Jan. 18, 1896, Baker St. from Valley St. to Broadway was paved with cobbles. The roadway of this street is 38.75 ft. in width. The block is 275 ft. long, and is paved for its entire length. The grade is 35.6 per cent. There are other examples of pavements having steep gradients in San Francisco, but the above will establish a record of pavements on steep streets. In passing I might say that such streets as the above would now be treated in an entirely different manner. under what we call our special treatment plan. JAMES M. OWENS, Highway Engineer.

San Francisco, Calif., Sept. 12, 1922.

Is Locating a Lost Art?

Sir—The article by C. K. Conard in *Engineering News-Record* for Sept. 28, 1922, p. 515, on reverse studies in railroad location brings to my mind the fact that locating is in the main a lost art. The old-time locaters under whom I worked when a younger man are nearly all gone and the wonderful art that these old masters developed has to a large extent passed away with them, for theirs was a knowledge not written in books and not easily explained.

All of the old-time experts located in both directions, not merely to run alignment that way but also to select the zones by inspection in both directions. In fixing the zone of operations by reconnaissance it is necessary to go forward, backward, sideways, and up and down, viewing the situation from every angle with the aid of such maps as can be secured. One or two preliminary surveys will usually suffice to limit the bounds of the prospective line, which, of course, is then worked out carefully on paper from contour maps. Being able to see in both directions on the map, it is of no concern in which direction the line is run, staked, and stationed. In the final revision, work is confined to detecting betterments in short stretches which can be viewed on the ground in both directions.

Any one who attempts, however, to locate in one direction without a careful map location closely studied from the grade contour will get a poor line, especially if the angle is large, the curve long, and the whole curve not visible from the P. I.

Balancing quantities from level-cutting tables after the map location has been made and the projected profile worked out usually is sufficient, but some engineers prefer to calculate quantities from projected cross-sections. As rock will swell and earth will shrink, too great a refinement is useless and all the preliminary borings available will not make cuts and fills exactly balance due to the ordinary mishaps of grading. The time spent in engineering help will cost more than the extended refinements can save in quantities.

Today, especially in highway work, too little money is spent for competent locaters and too much on office refinement in minute calculations, overlooking the fact that there may be thousands of dollars difference between a poor location and a good one. I have noticed this in mountain country. The reason is that, while nearly all of our chief engineers of railroads were once locaters, I doubt if 10 per cent

of our state highway engineers ever located a railroad.

Even now I see articles from time to time by highway engineers who write apparently as though they had discovered some new method of slope staking with a prepared tape and rod, or a new method of graphical computation of overhaul. These devices all were worked out long ago by railroad men along with many others not yet discovered by the newly-born highway engineers.

The fact is that all the methods of locating railroads are applicable at the outset in locating highways and unless the highway locater assimilates these principles through actual practice in railroad locating, we will continue to have poor highway locations. In our American Railway Engineering Association bulletins and occasionally through important suggestions such as that of Mr. Conard, the principles of locating can be presented and preserved. I should be glad to have the technical magazines give us more facts on so important a subject.

R. S. BLINN,
Locating Engineer.

Sparta, N. C., Oct. 3.

Abrasion Tests of Concrete Aggregates

Sir—Your issue of Aug. 17, 1922, p. 287, contained a letter by F. H. Jackson, Bureau of Public Roads, under the title of "Questioning Abrasion Tests," which offered certain criticisms of tests made in this laboratory. The tests referred to were contained in my paper before the American Road Builders' Association on "Selection of Aggregates for Concrete Roads," which has since been published in their 1922 "Proceedings."

The conclusions stated in that paper with reference to the value of abrasion tests were not reached solely on the basis of abrasion tests of aggregate, but included also many thousand compression and wear tests of concrete made from about 150 different coarse aggregates.

Mr. Jackson states that the "Rea method was not designed for and is never used for testing crushed stone aggregates." He overlooks the fact that this test was so used in our investigations.

The principal point of my discussion of the present standard wear test is that if the acceptance or rejection of crushed rock depends on minor details of the tests, otherwise similar, then the test method is not satisfactory.

TABLE I—METHODS OF MAKING ABRASION TESTS OF COARSE AGGREGATES

All tests were made in the Deval Abrasion Machine.

Method	Weight and Grading of Sample (Square-Mesh Sieves)	Abrasive Charge Cast-Iron 1¼-in. Balls	Total Revolutions	Remarks
A.S.T.M.[1]	5,000 gm.—2½ to 3 in.	..	10,000	50 pieces
Mattimore[2]	5,000 gm.—2½ to 3 in.	..	10,000	Same as A.S.T.M. except cylinders provided with 1/16-in. slots which allow fine material to escape as produced.
Rea[3]	2,500 gm.—¾ to ½ in. 2,500 gm.—½ to 1½ in.	6	10,000	Use volume of 0.11 cu.ft. in case of materials of unusual weight.
Abrams	2,000 gm.—¾ to ½ in. 2,000 gm.—½ to 1½ in.	10	2,000	Use volume of 0.09 cu.ft. in case of materials of unusual weight.

[1] Standard Method of Test for Abrasion of Road Materials, A.S.T.M. Standards, 1921, p. 710.

[2] Use of Slotted Cylinder for Abrasion Tests of Rocks; Report New York Commissioner of Highways, 1917, p. 62. Also Proc. A.S.T.M. Part II, 1918, p. 426. See results of tests made by this method by F. H. Jackson, Proc. A.S.T.M. Part II, 1920, p. 278.

[3] Abrasion Tests for Gravel Aggregate; General Specifications for Materials Ohio State Highway Department, Columbus; also Concrete Highway Magazine, June, 1918. Mr. Rea used screens with circular openings ½, 1 and 2 in. The wire cloth sieves with square openings used in our tests give approximately the same separation sizes as the circular screens.

The various types of abrasion tests are given in Table I and the results of such tests on a large number of aggregate in Table II. Compression and wear tests of concrete are given in Table III. The tests in Tables II and III are not exactly parallel, since Table II includes only the aggregates on which all the different types of abrasion tests were made.

Many thousand other tests were made in studying the performance of the Deval machine in tests of crushed rocks and pebbles in studying the effect of the following:

(1) Grading of aggregates on wear,
(2) Size of sample,
(3) Number of revolutions,
(4) Number and size of shot used,
(5) Shape of particles.

No report has been published on these tests. However, we believe the results given in the tables justify our conclusion that the Deval abrasion test gives little or no information as to the quality of aggregates for concrete road construction. The durability of a concrete road depends primarily on the *quality of the concrete*, and only to a slight degree on the quality of the aggregate. A very excellent concrete road may be built of inferior aggregate, if proper mixtures and methods are used; on the other hand, a very poor concrete road may result from a high-grade aggregate, if careless methods are employed. After examining a great many miles of concrete roads in different sections of the country, I have come to the conclusion that if more attention is given to restricting the quantity of mixing water used and to proper methods of curing, a great deal more latitude may be allowed in the quality of aggregate used. The above conclusions are borne out both by the very exhaustive laboratory investigations which we have carried out and by experience of many sections of the country in using aggregates which are generally considered inferior.

DUFF A. ABRAMS,
Professor in Charge, Structural Materials Research Laboratory, Lewis Institute.

Chicago, Ill., Oct. 9.

TABLE II—ABRASION TESTS OF COARSE AGGREGATES

Machine operated at 30 to 33 r.p.m.

See Table I for details of methods of making tests.

The per cent of wear was based on the weight of material finer than a No. 16 sieve, or which escaped through the 1/16-in. slots in Mattimore's method.

Method	Per Cent of Wear: Limestone (17)*	Trap (4)*	Granite (3)*	Sandstone (5)*	Slag (3)*	Pebbles (18)*	Grand Av.**
A.S.T.M.	4.8	2.2	1.9	5.0	8.7	0.9	3.9
Mattimore	12.6	4.7	3.8	6.9	17.8	2.6	8.1
Rea	21.0	7.4	18.3	29.5	13.7	10.0	16.6
Abrams	10.5	3.8	8.0	17.1	5.7	4.9	8.3
Average	12.2	4.5	6.0	14.6	11.5	4.6	9.2

* Number of different samples.
** Averages not weighted.

TABLE III—WEAR AND COMPRESSION TESTS OF CONCRETE MADE FROM MISCELLANEOUS COARSE AGGREGATES

Wear tests of 8 x 8 x 5-in. concrete blocks made in Talbot-Jones rattler.
Compression tests of 6 x 12-in. cylinders.
Mix 1:4 by volume of mixed aggregate; approximately same as 1:2:3 mix.
Relative consistency 1.10; about the same as should be used in the construction of concrete roads to be finished by hand.
Hand-mixed concrete; one specimen to a batch.
Cement; a mixture of five brands of portland cement purchased in Chicago.
Sand from Elgin, Ill., graded 0-No. 4, used as fine aggregate in all tests.
Each coarse aggregate was screened and recombined to the following grading: No. 4 to ¼-in., 25%; ¼ to ½-in., 50%; ½ to 1½-in. 25% by volume.
For each aggregate sample, the value for wear was the average of 10 tests and for strength, 5 tests, made on 5 different days.
Specimens stored in damp condition 14 days, then in air until tested at age of 3 months.

Kind	Coarse Aggregate: Number of Samples Tested	Unit Weight Lb. per Cu.Ft.	Specific Gravity Apparent	Absorption at 3 hr. Per Cent by Weight	Concrete Tests* (3 Months): Compressive Strength, Lb. Per Sq.In.	Depth of Wear, In.
Pebbles	24	102	2.56	1.17	4,330	0.51
Crushed Limestone	26	91	2.59	1.14	4,560	0.44
Crushed Granite	12	92	2.59	0.32	4,350	0.34
Crushed Trap	6	95	2.85	0.12	4,210	0.40
Crushed Sandstone	7	86	2.34	3.94	4,470	0.45
Crushed Slag	13	88	2.34	2.20	4,240	0.48
Crushed Flint	2	83	2.43	....	4,850	0.46
Crushed Marble	1	96	2.69	0.39	4,620	0.42
Crushed Lava Rock	1	90	2.62	2.50	5,350	0.40
Crushed Tufa	1	47	1.27	27.50	1,960	0.66
Crushed Fire Brick	1	70	1.92	4.55	5,390	0.43
Cement Clinker	2	88	2.22	8.20	5,160	0.37
Boiler Cinders	1	40	1.51	8.70	3,000	0.85

* Strength tests were also made at ages of 7 and 28 days, and 1 year on many of the aggregates.

NEWS OF THE WEEK

New York, November 9, 1922

Coal Commission Confronted by Many Questions

Staff Counts on Co-Operation From Trade Bodies—Far-Reaching Problems Involved

(Washington Correspondence)

The fact-finding machinery being set up, the President's coal commission is now taking definite form. While the commissioners expect to secure much of their information from the broad conclusions of outstanding men engaged in coal production, distribution, wholesaling and retailing, a vast amount of data must be collected by a technical staff. That portion of the work which deals with costs of production will be under the immediate direction of David L. Wing, whose title is to be expert investigator. C. E. Lesher, editor of *Coal Age*, has been drafted to direct the engineering investigations, and coal specialists from various bureaus will be transferred to the commission. A statistical program is being worked out which it is believed will cause very little dissension, and there is every evidence that the commission will have the whole-hearted co-operation of the entire coal business.

Statistical Compilations

Where statistical and other information is furnished by one branch of the industry, arrangements are being made whereby the other branches concerned and the commission itself can check the figures as they are being compiled. In this way it is hoped to compile statistical data, the correctness of which will be admitted by each branch of the industry.

Since the government's law officers decided that Dr. George Otis Smith may not lead a double official life, it became necessary for him to resign his position as director of the U. S. Geological Survey. After having discussed the matter personally with the President, Dr. Smith presented a formal resignation, which, the President has explained, is temporary. It is planned to reappoint him when his duties with the coal commission have been completed.

One of the most important questions the commissioners will have to consider is whether they will recommend amendments to the anti-trust statute, that will permit consolidations and that will permit of a scheme of collective marketing.

While it is possible that the commissioners may avoid a flat recommendation as to the rates of wage that they may regard as fair, it is certain that they must go deeply into the wage and living cost questions. In their report, they will be expected to discuss and express opinions on such questions as a minimum wage, a guarantee of employment and unemployment insurance.

It is not unreasonable to suppose that they will consider the place of trade unions in the business of coal production, especially when the organization of coal miners exerts so important an influence on the production of two-thirds of all the coal produced in the United States, which, incidentally, is nearly half the world's output. The commission is called upon to probe deeply into the affairs of the strongest labor union in the world.

While nationalization is specified as one of the points on which the commission must report, it is regarded as probable that it will be dismissed without extended discussion. It is probable that the commission will see in the cry for nationalization a reflection of the course that the public instinctively pursues when called upon to pay unusual prices as a result of manipulations for which it is in no wise responsible. Another big question with which the commission must wrestle is that of regulation, in connection with which it will be expected to express an opinion as to whether coal falls into the category of public utilities.

State Control of Water Power Defeated in California

Early returns from California in the general election held Nov. 7 indicate the decisive defeat of a proposed amendment to that state's constitution giving the state ownership and control of water power sites and authorizing the issuance of $500,000,000 in bonds to finance development. Indications are that the bill was defeated by a two-to-one vote.

$40,000,000 Road Bond Measure Fails to Pass in New Jersey

Legislation having in mind the provision of $40,000,000 for the construction of roads and bridges in New Jersey was defeated by the voters of that state in the general election held Nov. 7. Final results on the election were not available as this issue went to press, but the indications are the bond issue was defeated by about three votes to one.

Automobile Fatalities Increase

According to an announcement of the Department of Commerce, returns compiled by the Bureau of the Census show that during the year 1921, 10,168 deaths resulted from accidents caused by automobiles and other motor vehicles (excluding motor cycles). These deaths occurred within the death registration area, which contains 82 per cent of the total population. This number represents a rate of 11.5 per 100,000 population as against 10.4 in 1920; 9.4 in 1919; 9.3 in 1918 and 9 in 1917. Between 1917 and 1921, therefore, the death rate per 100,000 population increased about 28 per cent. In the 27 states for which data for 1917 are available, the actual number of these deaths increased 41.2 per cent. The rate per 100,000 population was highest in Los Angeles, with Chicago second, in a list of 66 cities.

Honor Dr. Hunt on Return From Netherlands Convention

To celebrate his return from Europe where he had attended the 75th anniversary of the foundation of the Koninklijk Instituut van Ingenieurs of the Netherlands, Dr. Charles Warren Hunt, secretary emeritus of the American Society of Civil Engineers, was the guest at an informal dinner held in the Engineers Club, New York City, on Nov. 3. Dr. Hunt attended the anniversary celebration as official delegate from the American Society of Civil Engineers and also in his personal capacity to receive the diploma of honorary membership which had been accorded to him by the Dutch society.

Francis Lee Stuart, formerly director of the American Society of Civil Engineers, presided. Among the speakers were Dr. Alexander C. Humphreys, president of Stevens Institute of Technology, past president of the American Society of Mechanical Engineers, and former director of the American Society of Civil Engineers; William L. Saunders, past president of the American Institute of Mining & Metallurgical Engineers, and John F. O'Rourke, former director of the American Society of Civil Engineers.

The speakers all expressed appreciation of the compliment extended to the American Society of Civil Engineers by the Dutch society in the election of Dr. Hunt as an honorary member and paid tribute to his long service as secretary during a difficult period of its development. Dr. Hunt responded with a brief account of his trip and of the courtesies extended to him by his hosts.

New York State Engineer Joins Consulting Engineering Firm

Frank M. Williams, who is completing his fifth year as state engineer of New York, has joined the Technical Advisory Corp., a consulting engineering firm of New York City. His active connection with the corporation will begin Jan. 1, 1923. However, in the meantime he will be available by appointment for consultation on certain matters which will not conflict with his official duties.

Mr. Williams will be one of the corporation's active principals specializing in advice on matters pertaining to water-power development, canal construction, highway and pavement building, public utility valuation, and railway and marine terminal development.

The Technical Advisory Corp. was organized in 1920 and is composed of a number of prominent consulting engineers.

Illinois Society Selects Peoria as Annual Meeting Place

The Illinois Society of Engineers has decided to hold its next annual meeting at Peoria, Ill., Jan. 23 to 25, 1923. E. E. R. Tratman, Wheaton, Ill., associate editor of *Engineering News-Record*, is the secretary.

Shallow Foundation Causes Building Failure

Failure of a factory building in Richmond, Va., on Sept. 15, has been found upon investigation to be due to a peculiar condition of shallow foundation. The facts as given by Allen J. Saville, director of public works, are as follows:

The collapsed building, of mill construction and four stories high, built less than ten years ago, stood on a side-hill site. The basement of the building adjoining on the downhill side, an older building, went down some 10 ft. deeper than the wall of the building which fell. Within the last few years the older building was torn down, but its uphill wall was left standing, to the street level, and acted as a retaining wall to hold up the ground below the footings of the adjoining building, though it had never been designed to perform any such function. It finally collapsed, without warning, and the adjoining wall simply kicked out at the bottom and dropped the building.

The accident occurred at lunch hour, when the machinery was not running and few persons were in the building. Five girls were eating lunch on the third floor in the room adjoining the falling wall, but due to the nature of the collapse they simply fell or slid from floor to floor as the building went down, and suffered nothing more serious than bruises.

No evidence was found that excessive rains had damaged the old wall. Apparently it simply fell without external cause. No excavation or other work was being done near the building.

Regular Airplane Express Service in California

The Pacific States Express Co. of San Francisco is now maintaining daily express service by airplane between San Francisco and Modesto to supplement that rendered by its motor trucks and boats. The airplanes are owned and operated by the Varney Aviation Co. under contract with the express company. Motor trucks deliver freight to the aviation field, thirty miles south of San Francisco and beyond the fog belt; and the eighty-mile trip from the field to Modesto is made in 1 hr. 15 min. The only stop enroute is at Stockton. It is planned to extend the service eventually to Sacramento and south to Fresno, Bakersfield and Los Angeles.

For the purpose of advertising the service and establishing confidence in its trustworthiness the daily trips are made regularly regardless of whether there is a load of freight and care is taken to have the planes start exactly on time. Planes always circle the valley towns before alighting, thereby making their arrival at exactly the same time each day a subject for local comment. The result has been that an encouraging amount of business has been received from the very outset.

Rates are 35 cents per pound or fraction thereof, with a minimum charge of $1. The planes now used have a freight capacity of 400 lb. but machines of 800 and 1,500-lb. capacity are available if and when the business requires them. Some of the classes of goods thus far consigned by this route are pumps and motors, automobile parts, grain samples for the Grain Exchange, hospital supplies, etc.

Merchants Association to Honor Men of Science

Engineers and scientists who have contributed most to commercial progress during the last twenty-five years will be the guests of the New York Merchant's Association at a mass meeting to be held in Madison Square Garden on Nov. 17 to celebrate the industrial growth of the city. It is announced that if Mrs. Harding's health will permit his absence from Washington, the President will be the principal speaker.

The guests announced by the association are: Thomas A. Edison, pre-eminent in the field of electrical invention and other arts; Charles P. Steinmetz, among the foremost in the study and development of the principles of electrical energy; Michael F. Pupin, a leader in electro-mechanical development; Lee De Forest, one of the pioneers in the development of wireless telegraphy in America; Luther Burbank, originator of new fruits and grains; Col. William Barclay Parsons, as chief engineer planned and constructed the first passenger subways built in America; Gen. George W. Goethals, designer and builder of the Panama Canal; J. Waldo Smith, designer and chief engineer of the Catskill water-supply system; Wilbur Wright, co-operating with his brother, Orville Wright, discovered and first successfully applied the principles governing human flight in heavier-than-air machines; Glenn Curtiss, pioneer in the development of aviation in America, who developed the hydro-airplane; Cass Gilbert, architect, creator of the Woolworth Building; Simon Flexner, bacteriologist.

General Contractors Nominate

In accordance with its by-laws the Executive Board of the Associated General Contractors of America recently nominated officers for the 1923-1924 term. W. E. Wood, president of the W. E. Wood Co. of Detroit, was nominated as president; H. B. Greensfelder, secretary of Fruin-Colnon Contracting Co., was nominated as vice-president at large and J. H. Ellison, vice-president of Winston Deer Co., Minneapolis, vice-president, Zone 4. Nominations for directors of the various districts were also made.

Montana Highway Department Prints New Publication

The first printed issue of the Montana Highway *News*, the official news publication of the Montana Highway Department, is being issued—this month (October). The issue is the seventh but is the first one to be printed, previous numbers having been mimeographed in the department's headquarter's office. The publication is devoted to the dissemination of knowledge of the work and problems of the Montana Highway Department and is being mailed free of charge to newspapers, county and city officials, contractors, interested citizens and others.

R. C. P. Coggeshall

R. C. P. Coggeshall, whose death on Oct. 21 was briefly noted in the issue of this journal of Oct. 26, p. 720, will be remembered by many as one of the deans of the water-works fraternity, remarkable for his genial and sympathetic manner, his wise and helpful counsel at water-works conventions, and his long and useful service to the city of New Bedford extending through some fifty years, during forty of which he was superintendent of water-works.

Mr. Coggeshall was born in New Bedford April 20, 1849. His primary education was secured at a private school and the Friends' Academy and later he became a student at the Rensselaer Polytechnic Institute, Troy, N. Y.

He gave up the life of a student the latter part of 1868 to become a clerk in the New Bedford Post Office. Five months later he accepted a clerkship at the Bay State Glass Works at East Cambridge. However, engineering still attracted him and in the May of 1872 he returned to New Bedford and became draftsman, surveyor and general assistant to the then superintendent of the Water Department. Five years later he was elected city land surveyor, an office now lost through the creation of the greater city engineering department. As that office did not require full time service, Mr. Coggeshall-did some private engineering work.

Soon after he settled in work in New Bedford he became (in the fall of 1872) an instructor in mechanical drawing in the public evening drawing school and kept on with that work until 1887.

Mr. Coggeshall's life was largely devoted to the development of water supply in New Bedford. He witnessed the construction of the Acushnet water system of New Bedford, designed for a supply of 50,000 people and saw its capacity increased in different ways until finally the system was abandoned in 1899, when it was superseded by the Quittacas system, of much larger capacity.

Early in 1919 Mr. Coggeshall was relieved of some of the cares of his office by the election to the Water Board of Stephen H. Taylor, assistant superintendent, an office created by the enactment of a special ordinance.

Mr. Coggeshall was a charter member of the New England Water Works Association, which was organized June 21, 1882, being its first secretary and holding office for ten years. In 1885 he was elected president of the association and at various times filled other offices. He contributed numerous papers to its gatherings and in 1915 was made an honorary member. He was a member also of the Boston Society of Civil Engineers, of the Connecticut Society of Civil Engineers and of the American Water Works Association.

Agricultural Engineers to Meet in St. Louis

The sixteenth annual meeting of the American Society of Agricultural Engineers is to be held at the Planters' Hotel, St. Louis, Mo., Dec. 27-29. Because of the geographical position of St. Louis it is anticipated a large number of agricultural engineers from all over the country will attend.

Engineer Board to Review Dallas Water-Supply Plans

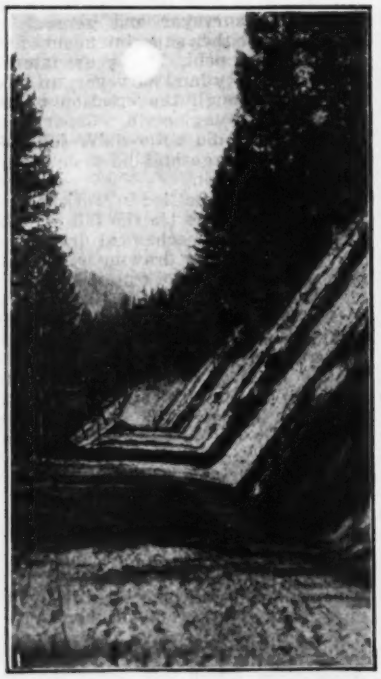
The Technical Club of Dallas, Texas, has offered the city the services of a board of engineers to review and pass upon various plans that have been submitted to the city for an additional water supply.

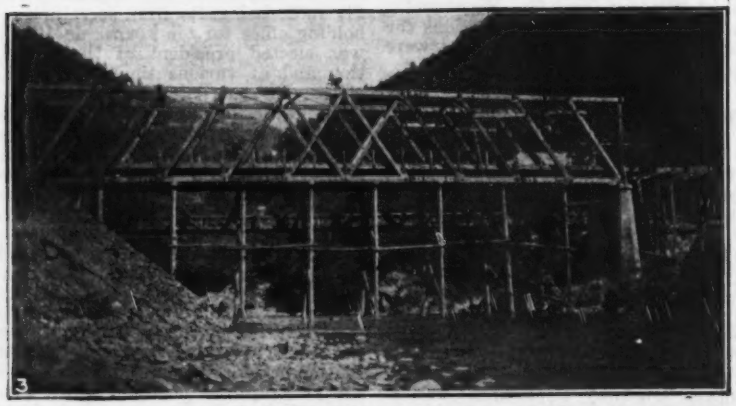
Dallas has a population of about 200,000 and for the past few years the City Plan Commission has studied the water situation from the point of making it adequate to serve a city of 500,000. The city has made some special surveys covering possible areas for impounding water.

The mayor and board of commissioners have accepted the offer of the Technical Club and it is expected that the personnel of the board of engineers will be announced at an early date.

Mountain Road Costing $24,000 Per Mile Soon to Be Opened

The Klamath River road which has been under construction by the federal government for the past four years, will soon be finished and opened to the public, according to official announcement. Although built by the government with the primary object of opening up the interior region of the Klamath National Park with its 28,000,000 ft. of timber, the road will have a far-reaching effect upon the development of the whole northwestern part of California. The accompanying photographs indicate the scenic beauty and picturesqueness of the country traversed by the road and the apparent extreme difficulty of constructing it. The road was constructed at a total cost of about $1,200,000, or an average of about $24,000 per mile. As the road is unsurfaced this cost went mostly for clearing and grading. The road begins at the end of the Siskiyou County road near Happy Camp and follows 50 miles down the rugged canyon of the Klamath River. The new road will open up a direct route from the Sacramento Valley to the Coast.





A 50-MILE FOREST ROAD COSTING $1,200,000
1 and 2—Views showing character of mountainous country traversed.
3—Bridge across Salmon River.

Utilities Seek Coal Priority to Build Up Winter Reserves

Washington Correspondence

Despite reassuring statements from the Department of Commerce and from the federal fuel distributor, representatives of the public utilities contend that the coal situation, so far as their plants are concerned, is getting worse instead of better. The figures of the American Railroad Association also are attacked as being inaccurate. The belief in public utility circles is that there are duplications in the figures as to car loadings. Since the utilities are hampered by fixed incomes in bidding for coal against manufacturers, they believe that nothing short of the re-establishment of Priority 2 will enable them to build up the reserves necessary to carry them through the winter.

Eastern and middle western utilities have been asked to await the closing of the Lakes before attempting to build up storage. They contend, however, that the closing of the Lakes means that freezing weather has arrived and a tonnage far in excess of that moving up the Lakes will have to be delivered to domestic consumers. Moreover, the advent of cold weather means that the railroads are 20 per cent less efficient. Transportation disability, the public utilities contend, will be even greater this winter because of the shortage of motive power and the run-down condition of that portion of railroad plant.

The point on which the public utilities are placing most emphasis in their representations to the fuel distributor and to the President's coal commission is that deliveries on their contracts frequently are as low as 15 per cent, while in rare instances only are they exceeding 50 per cent. The high prices being paid for coal in the Middle West have unbalanced the transportation movement from eastern mines and this situation is further curtailing the chances of the public utilities to secure reserves sufficient to insure the proper margin of safety.

Duty Imposed on Cement Imports from Canada

Pursuant to the permission granted in the retaliatory clause of the current Tariff Act, the Treasury Department has issued instructions to collectors of customs to collect a duty of 8 cents per 100 lb. on Roman, portland, and other hydraulic cements imported into this country from Canada. The act puts cement on the free list, but has a further proviso "that if any country, dependency, province or other subdivision of government imposes a duty on such cement imported from the United States, an equal duty shall be imposed upon such cement coming into the United States from such country, dependency, province or other subdivision of government." In the general tariff laws of Canada, cement is taxable as follows: "Cement, portland and hydraulic or water lime in barrels, boxes or casks, the weight of the package to be included in the weight for duty; British preferential tariff, 5 per cent; intermediate tariff, 8 per cent; general tariff, 8 per cent."

In the last few years the greater proportion of foreign cement imported into this country came from Canada, but the total imports are very small compared with the amount made in this country.

Canadian National Rys. Prepare New Administrative Plan

The new board of directors of the Canadian National Rys. returned to Montreal on Oct. 26 after an inspection trip of more than 5,500 miles covering the principal lines of the system west of Quebec. The board has secured extensive information regarding traffic and operating problems which will enable it, on the return of the new president, to decide the important matter of the location and division of headquarters. A tentative plan, subject to the approval of Sir Henry Thornton, proposes to make Toronto head of the central division, Winnipeg of the lines west of the Great Lakes, Moncton of the road formerly known as the Inter colonial, with Montreal as general headquarters. Sir Henry Thornton's office will probably be in Ottawa. The board is now in good position to determine the number of new cars and locomotives to order, and the number of branch lines which it will be expedient to construct in the west.

October Municipal Bond Sales Low but Ten-Month Total High

October sales of state and municipal long-term bonds totaled a little under $70,000,000, the smallest total for the year, according to *The Daily Bond Buyer*. For the ten months ending Oct. 31, the same authority reports, the sales were $1,118,399,987, compared with $948,135,416 for a like period in 1921, the highest previous total on record. The October and the ten-month's figures from 1922 to 1913 are as follows:

	October	Ten Months Ending October 31
1922	$69,895,558	$1,118,399,987
1921	125,126,375	948,135,416
1920	62,592,014	627,494,610
1919	117,284,139	634,775,848
1918	10,292,635	217,275,175
1917	22,834,348	389,598,640
1916	56,943,946	433,285,461
1915	27,620,693	422,985,369
1914	11,332,910	381,995,564
1913	33,772,990	327,817,224

New Tunnel Under Construction on Southern Pacific R.R.

The Southern Pacific R.R. on Oct. 25 awarded a contract to the Utah Construction Co. for the construction of a single track tunnel on the main line of the coast route in Monterey County. 155 miles south of San Francisco. At this point a spur of the mountain range projects out into the Salinas Valley to the edge of the Salinas River and in rounding the spur curves as sharp as 10 deg. had to be used in the original location. This necessitated a considerable reduction in speed in a territory that otherwise would have only long tangents and flat curves. To expedite train movements and increase the safety of operation a 1,200-ft. tunnel is now to be driven through the rocky spur. The line change required totals 3,100 ft. in length and makes possible the substitution of a simple 2-deg. curve for the series of sharper curves now used. The tunnel will be lined with reinforced concrete 16 in. thick except in solid rock sections.

The Engineer in Public Life

WARREN STOUTNOUR

Warren Stoutnour, of Salt Lake City, now serving a second term as a member of the Public Utilities Commission of Utah, member of the executive committee of the Intermediate Rate Association and commander of the Salt Lake City Post of the American Legion with an enrollment of 1,400 ex-service men, is a civil engineer graduate of Lafayette College (class of 1903) with professional experience covering railroad work, bridge design and general contracting. He was born at Everett, Pa., 39 years ago and after leaving college he entered the employ of the Harriman Line railroads in the West. He served this connection in order to get in direct contact with construction work and for 3½ years served as foreman and superintendent with a contractor on the Pacific Coast.

Mr. Stoutnour went to Utah in 1912 and designed steel bridges for the Salt Lake & Ogden Ry. Co. and the Utah Ry. Co. Later he was made superintendent of construction and maintenance, Salt Lake & Ogden Ry. Co. His appointment as a member of the Public Utilities Commission of Utah occurred in 1917. During the war he served in the United States Navy as lieutenant, senior grade, Civil Engineer Corps, in the Hampton Roads district.

The Intermediate Rate Association on whose executive committee Mr. Stoutnour is serving, comprises some 500 commercial clubs, associations and public service commissions in ten Western states. Its purpose is to prevent discrimination against the intermountain territory and to oppose the charging of a greater freight rate upon east- or west-bound transcontinental traffic at any intermediate point than is charged to more distant points.

The chairmanship of the accounting committee, National Association of Railway and Public Utility Commissioners, is another of Mr. Stoutnour's activities.

"In accepting public service," Mr. Stoutnour says, "the engineer will find that engineering questions enter into almost every avenue of endeavor. This must be increasingly true as our civilization becomes daily more complicated and technical. An undue amount of professional modesty, it seems to me, is keeping the engineer from exerting the influence upon the public that his knowledge and experience qualifies him to do. In other words, as an average, engineers do not seem to make themselves aggressively felt in the community, as do some of the other professions. Until they do, they will not rightfully occupy the place that is theirs. Neither will compensation be commensurate with the time and money necessarily expended in fitting themselves professionally."

Tentative Railroad Valuations Nearing Completion

The Interstate Commerce Commission has issued notices of hearings on the tentative valuations of forty railroads. This is the largest block of hearings on valuations of railroads yet announced. As a rule, the hearings are on exceptions filed by the carriers against the valuations placed on their properties by the commission in the tentative reports which in the absence of protest would have become final. All these hearings are to be held before the end of the year.

The commission also issued this week its first complete final valuation, which covers the Evansville & Indianapolis R.R.

The commission is entering upon the final stages of the most monumental scientific valuation of property ever attempted, the property being scattered over approximately 250,000 railroad miles. Its expectation is that the tentative reports will be completed in the next two years, together with a very large number of final reports. There will remain, however, the continuing work of keeping the valuations up to date. Practically all of the field work has been completed. The commission is now concentrating upon the completion of reports upon the major properties.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The San Francisco Section, Am. Soc. C. E., at the regular bi-monthly meeting on Oct. 17 listened to a paper on "The Work of the Bureau of Public Roads" by Dr. L. I. Hewes, deputy chief engineer, U. S. Bureau of Public Roads who is now stationed in the San Francisco office. There was also a talk by A. Griffin, superintendent of the eastern section, Canadian Pacific Ry. Irrigation block, Brooks, Alberta, in the course of which he described very rapid deterioration of concrete in that district due to the attacks of alkali salts. Moving pictures of the Hetch Hetchy excursion made in connection with the fall meeting of the patent society were shown.

The Texas Section of the American Society of Civil Engineers held its fall meeting at San Antonio, Oct. 20 and 21. Technical papers were presented dealing with the engineering problems involved in many of the public works of the state. The section endorsed the movement for reclamation and flood

control as advanced by the Texas Conservation Association, directed the appointment of a committee to confer with the state highway engineer in recommending legislation as to roads, bridges, and ferries, and authorized the appointment of a committee to report on spillway and wasteway dimensions. The officers elected were E. E. Sands, president; A. J. McKenzie, first vice-president; John A. Norris, second vice-president. As the secretary holds office for two years, E. N. Noyes continues in that office for the ensuing year.

The New England Water Works Association, through the nominating committee appointed at the recent New Bedford convention, has prepared a list of nominees for offices of the association for 1923, which follows:

President, Percy R. Sanders, superintendent of water-works, Concord, N. H.; vice-presidents, George A. Carpenter, city engineer, Pawtucket, R. I.; Reeves J. Newsom, commissioner of water supply, Lynn, Mass.; David A. Heffernan, superintendent of water-works, Milton, Mass.; Frank E. Winsor, chief engineer, board of water supply, Providence, R. I.; Theodore L, Bristol, president and manager Ansonia Water Co., Ansonia, Conn.; Vernon F. West, treasurer and manager of water companies, Portland, Me.; secretary, Frank J. Gifford, superintendent, Dedham Water Co., Dedham, Mass.; treasurer, Frederic I. Winslow, division engineer, metropolitan water-works, Framingham, Mass.; editor, Henry A. Symonds, consulting engineer Boston, Mass.; advertising agent, Fred O. Stevens, superintendent of water-works, Weymouth, Mass.

PERSONAL NOTES

F. T. MACK, chief engineer of the Sunnyside Valley Irrigation Co., of Sunnyside, Wash., has tendered his resignation.

R. M. BEANFIELD, civil and mechanical engineer, has opened an office in the Brix Bldg., Fresno, Calif.

JOHN STEPHAN WORLEY, of Worley & Black, accountants in New York City, and formerly consulting valuation engineer to the Interstate Commerce Commission, has been invited to become Professor of Transportation and Railroad Engineering at the University of Michigan. Mr. Worley has indicated that he will accept.

F. H. STEPHENSON, for the past three years assistant civil engineer on the design and construction of the Detroit Filtration Plant, has been appointed assistant superintendent, Detroit Department of Water Supply. He succeeds W. M. Mitchell, who recently resigned.

ROBERT S. PARSONS, vice-president in charge of operations on the Erie R.R., has been appointed vice-president of the Ohio region with headquarters at Youngstown.

W. A. BALDWIN, manager of the Ohio region of the Erie R.R., has been appointed vice-presdent in charge of operations, with headquarters at New York.

H. D. ROBINSON and D. B. STEINMAN, New York City, have been retained to act jointly as consulting engineers on the design and construction of a suspension bridge of 1,114-ft. span at Florianopolis, Brazil. The bridge will carry a highway, electric railway and aqueduct and will have 1,660 ft. of approach spans. The estimated cost is $2,000,000. With Messrs. Robinson and Steinman is associated L. N. GROSS as consulting engineer on erection. The contract has been awarded to a Brazilian firm, Byington and Sundstrum, São Paulo. The American Bridge Co. will fabricate the steelwork.

DR. J. A. L. WADDELL, consulting engineer of New York City, has been elected an honorary member of the National Society of Engineers of Barcelona, Spain.

R. B. ALLPORT, of the Allport Construction Co., Richmond, Va., was recently elected president of the Virginia Contractors Association.

DR. EDOUARD G. DEVILLE, for the past 37 years surveyor-general of Canada, was created an honorary life member of the Engineering Institute of Canada at a luncheon held by the Ottawa branch of the Institute Oct. 31.

C. R. THOMAS, editor of *Professional Engineer* and in charge of public information for the American Association of Engineers, has resigned to accept a position with La Salle Extension University as assistant to the Director of Publicity.

E. B. POWELL of Stone & Webster, Inc., of Boston, sailed Oct. 28 on the Majectic to make a study of recent developments in European power-plant practice. He expects to visit England, France and Germany and to return to this country early in December.

FRDERIC WILLIAM LYON, division engineer of the bureau of water, Pittsburgh, has been appointed by the director of public works of that city chief engineer of the bureau of engineering. Mr. Lyon replaces Charles M. Reppert, whose resignation was noted in these pages recently. Mr. Lyon has been in the service of the city for eleven years, having started as an assistant engineer during the building of the Aspinwall pumping station. During his early professional career he was with the Isthmian Canal Commission for several years, in the office of the chief engineer of the Bolivian National Rys. and stationed at La Paz, with the Pennsylvania State Highway Department, and the Pittsburgh Flood Commission. Until a definite appointment is made E. J. UMSTEAD, division engineer of the mechanical department of the bureau of water, will be Mr. Lyon's successor as head of the mechanical department.

GEORGE I. OAKLEY, former field superintendent for the Guaranty Construction Co., New York City, has joined the staff of the J. G. White Engineering Corp.

FREDERICK W. SARR, first deputy highway commissioner, and JOHN F. HUBER, senior assistant engineer of the New York State Highway Commission, were seriously injured in a recent automobile accident, at Poughkeepsie, N. Y., in which one person was killed. The machine in which they were driving, in an attempt to avoid a collision with another machine, skidded and crashed into a tree and overturned. Mr. Sarr received a compound fracture of the left leg and internal injuries, and Mr. Huber contusions and abrasions of both legs.

DR. GEORGE OTIS SMITH has resigned as director of the U. S. Geological Survey so that he might legally qualify as a member of the President's coal commission. It is understood that this resignation is purely temporary and made to remove all obstacles to his becoming a member of the commission. During his absence, PHILIP S. SMITH, who has been serving as the survey's administrative geologist, will become director.

DAVID WHITE will soon resign as chief geologist of the U. S. Geological Survey, and will resume private research work. He will be succeeded in the office of chief geologist by W. C. MENDENHALL. Mr. Mendenhall has been a member of the survey staff for twenty-eight years, for more than ten years of which he served as geologist in charge of the land classification board. Mr. White would have completed ten years of service as chief geologist of the Geological Survey in December.

OBITUARY

T. DEWITT CUYLER, chairman of the Association of Railway Executives and director of the Pennsylvania, the Santa Fe, and the New York, New Haven & Hartford and other railroads, died on Nov. 2 in his private car as it was entering Philadelphia from Rochester, N. Y., where he had spoken the preceding day on railroad matters. Mr. Cuyler was of Dutch ancestry and was born in Philadelphia, Sept. 28, 1854. He graduated from Yale University in 1874 and was admitted to the Pennsylvania bar. He was active in the National Guard and attained in its service the rank of colonel. Following the example of his father, who had been general counsel of the Pennsylvania Railroad Co., Mr. Cuyler entered railroad work and became a director of the Pennsylvania R.R. in 1899, of the New York, New Haven & Hartford in 1910, and later of the Maine Central, the Atchison, Topeka & Santa Fe, the Long Island, the International Ry. of Buffalo, the Interborough Metropolitan and Interborough Rapid Transit Cos. of New York, and the Long Island Consolidated Electric Co. He was associated also with many financial and industrial enterprises. For several years he has been the recognized spokesman of the railroad interests of the country and during the recent shopmen's strike occupied a prominent place in the councils of the executives.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Cement Demand Peak Taxes Transport Facilities

Makers Face Problem of Shipping 40 Per Cent of Year's Production in 90 Days

By L. R. Burch

Assistant to the President, Atlas Portland Cement Co., New York.

SEASONAL demand, governed largely by activity in the building and general construction industries which is always greatest in the warm months, is a controlling influence in cement shipments. To move this year's cement production, estimated at 120,000,000 bbl., about 600,000 cars are necessary, not including those required for coal and other materials used in the process of manufacture. Of this total almost 40 per cent, or 240,000 cars, must be moved within a period of 90 to 100 days —from the latter part of July to the beginning of cold weather. This short space of time constitutes the neck of the bottle and, unfortunately, it occurs at the season when the railroads are called upon to carry the heaviest traffic.

Furthermore, because the raw material, called "cement rock," from which portland cement is manufactured, can be found only in certain sections of the country, portland cement mills are frequently grouped, a circumstance which adds greatly to the burden of the railroads. Were the plants distributed over a larger area the tension would be relieved. This is an extremely important fact, because it has a tendency not only to increase car shortages, but result in embargoes and other conditions which are the outcome of overladen transportation.

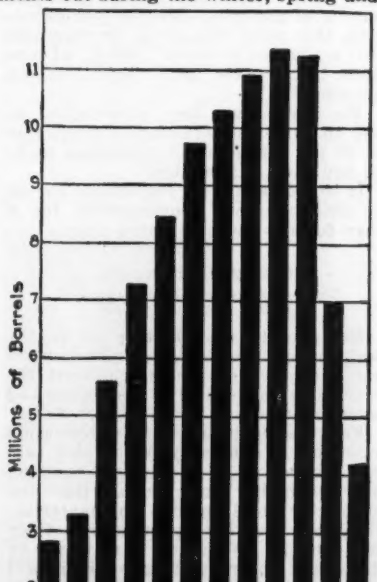
How Demand Varies

The accompanying chart shows the shipments of cement by months averaged for the years 1919, 1920 and 1921. From the low level of less than 3,000,000 bbl. in January it reaches the peak of over 11,000,000 bbl. in September and October, dropping off sharply in November to less than 7,000,000 bbl. Upon the ability of the cement companies to meet this peak demand depends, to a great extent, their year's profits. They plan to have their stocks and their production in such shape as best to handle the problem. In fact, their whole operation might be said to be regulated with this condition in mind.

With traffic conditions such as have existed in the past few years it has been impossible for the railroads to handle the volume of business that is thrown upon them. If the cement peak came when freight shipments were light it could be done, but just when the construction job needs building materials the farmer also needs cars to move his crops.

The cement manufacturers would be more than glad to correct such a serious evil in their business, for it is expensive from many different angles. But they cannot correct it. They cannot do more than make helpful suggestions.

This is their suggestion: Inasmuch as car shortages and railroad congestion will be with us until the railroads are able to get back on their feet, transportation facilities must be used while they are available. This means that every effort must be made to get shipments out during the winter, spring and early summer. To do so may entail some inconvenience and some expense, but neither is commensurate with the losses that result from delays apt to occur later on. Co-operation of the various branches of the construction industry toward the elimination of the peak load, by spreading shipments more evenly throughout the year, would mean a vast saving to everyone concerned.



AVERAGE MONTHLY SHIPMENTS OF PORTLAND CEMENT IN U. S., 1919-1921

Ban on Operating Machinery at Road Show Removed

By a decision of the committee in charge of arrangements for the Good Roads Show and convention to be held in Chicago, Jan. 15-19, the technical sessions will be held at the Congress Hotel, while the exhibits will be staged in the Coliseum. This will remove the ban on the operation of machinery during the convention sessions, which, when previously held in the Coliseum, were interfered with by the noise of the machines on the floor below.

Are New "Styles" in Demand for Construction Equipment?

A demand for constantly changing "styles" in rock drills is indicated by "Engineering and Mining Journal-Press" in an editorial reprinted below. Do manufacturers in the general construction field encounter the same conditions, for example, in the case of concrete mixers, steam shovels, cranes, hoists, buckets, motor trucks and other types of equipment? Comment is invited.—Editor.

"The multiplicity of rock drills and the speedy replacement of one type by a newer design has often been ascribed to competition between ambitious and progressive manufacturers. Undoubtedly, competition has been a primary cause, but one prominent drill manufacturer who discussed the subject with us recently ascribed the reason to the mine superintendent and manager. He said that when a salesman approached a manager, the salesman would be confronted with the question: What have you got that is new? Thus the demand for novelties has apparently come from the mines.

"New fashions are in order. Despite the repeated changes in drilling equipment, our drill manufacturer asserts that the average drilling performance of today does not greatly exceed the best obtained by the piston-drill equipment, once the standard. This is not the fault of the new drills, as their performance almost doubles that of the piston drill. It is attributable to the driller and his policy of holding back. As a result there is a capital input for drilling equipment that is not earning its way. The new drills require less manual effort, even with increased output, as compared with the older types. The mining company pays a stiff price for every change in design or added improvement in the drill and its accessories. A commensurate return in performance should result. Without it, there is a cumulative money loss that must necessarily have its effect upon the industry generally."

Seven Grades of Asphalt Ample, Says A. B. Fletcher

Supplementing the recent discussion in these columns by highway officials of the proposal to limit the number of varieties of asphalt to 7 (by the penetration test) the following comment has been received from A. B. Fletcher, state highway engineer of California:

"I agree with the producers' point of view, that for all practical purposes not more than 7 grades of asphalt are justified, and in my opinion we can get along very nicely with even a smaller number than this. The California Highway Commission specifications already comply very closely with the specifications suggested by the Asphalt Association and by the American Society for Testing Materials, except for the lower limits for penetration.

"At present we are not using much asphalt on state highway work in California with a penetration of less than 50, as it is felt that the value of asphalt of a lower penetration is still subject to demonstration. In localities where extreme heat conditions prevail we have used as low as from 30 to 40 penetration, but only in special cases.

"In general, however, it can be borne

in mind that California is not confronted with numerous varieties of bituminous products which are available in other states. It has not been considered necessary, therefore, to specify certain characteristics, since it is known that all California asphalts are practically standard between penetration limits."

To Allot Exhibit Space for Good Roads Show

Allotment of space for the Good Roads Show, to be held in the Coliseum, Chicago, Jan. 15-19, will take place Nov. 17 according to a decision reached Oct. 27 at a meeting in Chicago of the directors of the Highway Industries Exhibitors Association. Several plans of conducting the drawing and assigning space to exhibitors were discussed and by resolution the Exhibitors Committee was empowered to decide upon the procedure which, in its opinion, would best serve the interests of the exhibition and the manufacturers.

At the meeting of directors organization and constitutional details were approved and all of the old officers were re-elected to serve until March 1, 1923, when a new fiscal year will begin. The present directorate also will serve until that date.

Winter Buying of Pipe

Discussion continued from last week's issue.

FRANCIS T. CUTTS
Assistant Water Commissioner, St. Louis

Locally, money for the purchase of pipe is appropriated from water-works revenue by the Board of Aldermen, and of course no money can be appropriated unless the funds in water-works revenue are sufficient to cover the appropriation. Such appropriations are usually made in the spring of the year and contracts for the pipe would ordinarily be ready for letting about May or June, anticipating the delivery of pipe during the summer and fall. In the past this has generally been the practice followed. This year, however, bids for pipe were received during the first week of October calling for delivery during the fall and winter. I can see no reason why it would not be possible in most cases to anticipate needs for a year's business and purchase the material for delivery over an extended period.

In the locality of St. Louis winter construction is generally possible with the exception of about sixty days—that is, during January and February. We have found, however, that it is difficult to restore street surfaces to a satisfactory condition at a time when the weather is below freezing, and for that reason work during the winter can best be handled in the sparsely settled outlying districts.

The City of St. Louis has made a practice of furnishing an inspector at the foundry, and in order to keep inspection costs at a minimum it is, of course, desirable to have any individual order made up within the minimum time at the foundry.

It has not been our experience that the pipe manufacturers have exerted themselves in offering any price differentials that would encourage buying during the winter months. If such differentials were made, it would undoubtedly encourage purchases at that time.

St. Louis has never had any great difficulty in getting contracts promptly filled, regardless of the time of year at which the contract was let. In recent years our purchases of cast-iron pipe have been comparatively small and I presume that, under any arrangements, deliveries on contracts entered into at this time would be very much delayed. I believe, however, that some benefit might accrue if the pipe manufacturers would indicate a willingness to cooperate with the water-works departments in this respect.

W. S. CRAMER
Chief Engineer, Lexington (Ky.) Hydraulic & Manufacturing Co.

In this locality it is practical to lay pipe, with few exceptions, at any time of the year and if a price was made that was attractive a great deal of work would probally be done in winter months in a greater part of the country.

With our company we make most extensions on order from the city commissioners and this only where additional fire protection is needed. Most of the other extensions are made for development companies on such short notice that there is no time to anticipate the buying of material. Most of our extension this year was in a development that amounted to about 7,000 ft. of pipe with but a few days' notice of requirement.

We have never been approached to buy on winter schedule and a recent rise of $6 per ton does not encourage us to do any work this winter.

It would be almost impossible for us to anticipate our requirements for a year for the reasons stated above.

GEORGE H. FENKELL
General Manager, Department of Water Supply, Detroit

Replying to your inquiry as to the desirability of water-works plants making purchases of pipe throughout the year rather than during the spring and summer months:

For the purpose of this discussion municipal plants may be divided into two classes: (1) those that contract for pipe-laying and provide that the contractor shall furnish the material; (2) those that lay the pipe with their own forces. With the first class, or those that contract their work, it will be necessary for the department to purchase the pipe and furnish it to the contractor, and while this may be done at times, I do not expect it will become a general practice. The contractor delivers the pipe from the cars, and as many of the departments are without storage facilities, I would expect that the present practice of buying during the working season would be continued.

The second class, or those departments that lay the pipe themselves, can spread the purchase through the year provided storage yards are available. Many departments are not provided with such yards, cranes and skidways, and so they prefer to haul direct.

I believe the purchase of pipe will be continued through the year when the foundries can prove to their customers that it will work to the latter's benefit financially.

Business Notes

AUSTIN MACHINERY CORP. has moved its general offices from Chicago to Toledo, Ohio, address Station C, Dorr St.

JOSEPH T. RYERSON & SON, Chicago, manufacturers of steel products, announce a celebration in honor of the company's eightieth anniversary this month. Joseph T. Ryerson arrived in Chicago 1842, rented a small two-story brick building at Clark and Water Streets for $200 per year and began business with a $20,000 stock of iron received from Pittsburgh. Today the Chicago plant of the company occupies a ground area of over 19 acres with nearly a million square feet of floor space. There are four other complete steel service plants in addition to offices in the principal cities. Mr. Ryerson died March 9, 1883, and was succeeded as president of the company by his son, Edward L. Ryerson. In 1912 when Mr. Ryerson became chairman of the board of directors Clyde M. Carr was appointed to the presidency.

RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., due to an increased volume of business, particularly in the paving and small mixer fields, has decided upon a further enlargement of its plant. About a year ago the company doubled its floor space and the new extension to be undertaken now provides for an increased floor area of 33⅓ per cent in a new one-story building. The structure will have a monitor roof, will be of concrete and steel and will cover a ground area of nearly 10,000 square feet. Its erection will be commenced immediately.

THEODORE HENRY announces that he has severed connections with J. H. Burton & Sons Co., Inc., and has opened an office at 299 Madison Ave., New York City, to engage in the wholesale yellow pine and fir lumber, oak, and pine piling business under the firm name of Theodore Henry, Inc.

HEYL & PATTERSON, INC., Pittsburgh and New York, have received from the City of Providence, R. I., the contract for two traveling, revolving boom cranes of the hammerhead type for handling lumber at the new modern lumber storage yard now under construction at Fields Point. These cranes are to have a maximum working radius of 90 ft. and a capacity of 5 tons with a two-speed gear shifting arrangement built into the hoist engine so that loads lighter than 3½ tons in weight can be handled at a hoisting speed of 200 ft. per minute, whereas loads between 3½ and 5 tons will be hoisted at the rate of 100 ft. per minute. Bids for these cranes were opened in Providence on Sept. 5. The A. C. Dutton Lumber Corp., lessees of the Fields Point lumber storage development, have likewise awarded to Heyl & Patterson, Inc. a contract for two motor-driven lumber-carrying portals of 50 tons capacity, which are to be used in connection with the above-mentioned cranes.

THE HUBBARD MACHINE CO. has opened new offices and works at 969 Folsom street, San Francisco, Calif., and will specialize in all classes of machinery and plant installation.

Equipment and Materials

Motor-Truck Mounting Widens Loader's Operating Range

In its new path-digging bucket elevator, mounted on a motor-truck chassis, the George Haiss Manufacturing Co., New York, has developed a machine to meet requirements for

rapid loading with a single unit at a number of widely separated points. Examples of conditions to be met by this machine are indicated by the following: A coal dealer may have many yards, a contractor may receive material at different points, a material dealer may operate at several storage sites, the volume of work at only one place being insufficient to justify the purchase of loading apparatus. With a single mobile loader, however, many points may be served, as the truck can travel at speeds of 15 to 20 miles per hour.

In the machine illustrated herewith the regular A-frame supports on which the elevator is pivoted are erected over the rear axle of the truck, and the necessary transmission gearing, chains, etc., are placed as on standard loaders. The elevators are equipped with feeding propellers, so that no shoveling is required to clean a path into the pile for the loader chassis. Buckets are equipped with cutting teeth and a two-way side-discharge chute permits trucks to be loaded on either side.

When the truck chassis is equipped with a jackshaft for operating a body-dump hoist the elevator is driven by it; when not so equipped, a second motor is installed to drive the elevator. The second plan, while more expensive, gives better operation, the manufacturers state, as the loader can be backed into the pile while the elevator is operating. The loading capacity of the machine is from 1 to 2 cu.yd. per minute. The loader illustrated was timed by its manufacturers to load 4 tons of egg coal in 3 min. 40 sec., or at a rate of more than 1 cu.yd. per min.

Of the trucks which have been equipped with Haiss loaders one is in the hands of a large New York coal dealer who has several yards widely scattered throughout the Bronx; another is owned by a contractor in Toronto who has several gravel banks some miles apart and is also receiving material by rail; and a third belongs to a large trucking company in New York which uses the loader in connection with the hauling of ashes, sand and gravel and earth spoil.

Skip Guard for Paving Mixer

The Chain Belt Co., Milwaukee, is now equipping its Rex pavers with a patented, automatically operated guard which prevents workmen, or others, from getting beneath the charging skip while it is elevated. Heretofore skip guards used on pavers provided for the sides only, but did not prevent anyone from accidentally walking beneath the skip from the end. They were also stationary and to a certain extent interfered with efficient charging, especially with the industrial railway system.

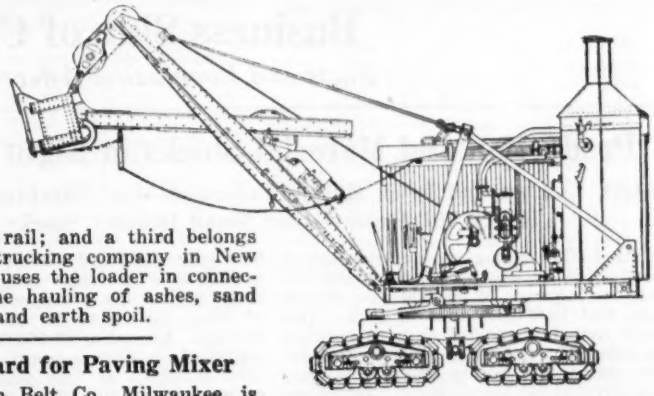
The Rex skip guard, illustrated herewith, completely surrounds the skip buckets but does not interfere with the charging of the paver. When the skip is down and the guard is not needed, it rests on the ground. Trucks and wheelbarrows can pass over it while boxes can be transferred from industrial railroad cars to the skip without interference from the guard.

As the skip rises, the guard also rises automatically to a position approxi-

mately 3 ft. off the ground. Here it is held, again automatically, until the skip returns to the ground. In the illustration the skip guard is shown just as it is rising into position while the skip is being elevated. The picture was taken on the Twohy Bros. project, near Tucson, Arizona.

Convertible 1¾-Yd. Revolving Shovel Has New Features

With a 1¾-yd. dipper, 25-ft. boom, and 17-ft. dipper handle, the new model 37 is announced as the largest of the Marion Steam Shovel Co.'s small revolving-type shovels. It is convertible into a dragline, clamshell or orange-peel bucket excavator. Three optional types of mounting—crawling traction, traction wheels, or railroad wheels—are provided. On standard and high-lift shovels the boom and dipper handle are a combination wood and steel, while for dragline or clamshell work the



boom is all-steel construction spread at the foot to resist side sway incident to sudden starting and stopping. The entire front of the dipper is a single manganese steel casting riveted to the side plates.

The hoisting engines are direct-geared to the drum which has a grooved barrel of sufficient length to require only a single wrap of the cable to raise the dipper to its highest position. Gears and pinions are of open-hearth steel, annealed and heat-treated, and have machine-cut teeth. For dragline or clamshell work an extra drum may be attached in tandem with the hoisting drum. Digging and rotating operations are entirely controlled by three hand-levers and a foot brake.

The lower or truck frame is formed from a large openhearth steel casting—a form of construction which the manufacturers claim is entirely different from anything heretofore produced for a machine of this size. The boiler is of the vertical through-tube type, the tubes being electric-welded at both ends to prevent leaks.

The design provides for the addition of parts necessary to convert the standard shovel into a clamshell, orange-peel, or dragline excavator, or into a material-handling crane. Any one of several combinations can be effected.

Publications from the Construction Industry

Steel Structures — McCLINTIC-MARSHALL Co., Pittsburgh, designers, manufacturers and erectors of steel structures, indicates the scope of its service in a 69-p. book of photographs of buildings of all types which it has constructed. The views cover a wide range of structures, including shops, office buildings, factories, pier sheds, power stations, department stores, warehouses, cold storage bins, airship hangars, shipyard runways, roundhouses, and lock gates for the Panama Canal.

Conveyor and Elevator Chain—BROWN HOISTING MACHINERY Co., Cleveland, in a 12-p. illustrated catalog, describes various sizes and types of dropforged chain for conveyors and elevators. The bar of the link is an I-beam section, designed to produce great rigidity, while the upset ends provide a large wearing surface. Tables are given designating each type of chain by number and containing other detailed information.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Material Stocks in Eight Cities

Steel, Lumber and Brick Output Increased—Car Shortage Causing Heavy Mill Reserves but Small Dealers' Stocks

Steel—The annual rate of steel ingot production is now at about 37,000,000 tons as against 32,000,000 one month ago, and 19,000,000 tons in 1921. The steel industry generally, is proceeding at about 75 per cent of capacity, despite the perceptible falling off in steel buying throughout the country. Inquiries, however, regarding 45,000 new freight cars are pending in Chicago. Although production is increasing slightly, the bulk of the output applies on back-log tonnages. Rail embargoes still greatly impede steel shipments.

Lumber—An average of 388 mills reporting to the National Lumber Manufacturers' Association, for the four weeks ending Oct. 21, show 974,259,065 ft. cut; 753,901,097 ft. shipped and orders covering 750,330,122 ft. b.m. This represents a gain of 5 per cent in output; a falling off of over 6 per cent in shipments but a decrease in orders of only 0.7 per cent, as compared with the four weeks ending Sept. 23. According to the latest reports, production is still only 2 per cent, while shipments have dropped to 28 per cent and orders, 27 per cent below normal.

Cement—Manufacturers report 2,227,000 fewer bbl. of cement on hand Oct. 1 than were available at the same time last year, yet 9,256,000 more bbl. were produced in the nine months of 1922 than during the corresponding period of 1921, according to the Geological Survey. A total of 81,563,000 bbl. were produced in this country during the three-quarters of this year while the entire output for 1921 amounted to 98,842,049 bbl., indicating that total production for 1922 will probably exceed the output for the preceding year by about 9,000,000 bbl. Shipments, from Jan. 1 to Oct. 1, 1922, reached 88,684,000 bbl., an increase of nearly 20 per cent over the same period last year.

Brick—Out of eighty-one firms reporting to the Common Brick Manufacturers' Association of America for the month of October, only two were closed for lack of coal and one by car shortage. Total production for the month was 95,192,000 brick, with shipments of 78,000,000. There was a slight reduction of orders on books during the month; stocks of unburned brick on hand increasing over 17,000,000.

San Francisco—Kiln products plentiful with unlimited supplies to draw from; cement stocks still low. Lumber being used almost as rapidly as received from mills; no reserve stocks. Native asphalt always available in any quantity. Fair stocks of structural steel; nails and rivets scarce.

Denver—Car shortage holding up lumber deliveries particularly from Pacific Northwest. Local dealers' stocks sufficient to meet present demand. Brick supply good; cement stocks running low.

Minneapolis—Local lumber dealers' stocks about 20 per cent below normal, with probably 50,000,000 ft. in yards. Stocks piling up at lumber mills owing to shortage of cars for making deliveries to dealers. Brick and hollow tile stocks show improvement over last month but only small quantities available. No shortage of lime. Cement warehouses depleted, what shipments are received are delivered to job from cars. No asphalt available; road jobs being held up awaiting shipments.

New Orleans—Plenty of sewer pipe, cement, brick and hollow tile but no market for asphalt and crushed stone. Lumber stocks about 25 per cent of normal. Scarcity of cars holding up mill deliveries, particularly of lumber, sand, and gravel.

Atlanta—Scarcity of crushed stone; brick and lumber plentiful. Situation improving somewhat as compared with last month. Deliveries still being held up, however, particularly on highway construction materials, owing to present freight situation.

Philadelphia—Sewer pipe stocks depleted because of slow rail deliveries from mill. Lime being sold faster than received. Some grades of lumber still to be had in quantities but rail situation affecting mill shipments adversely. Heavy reserves of asphalt. Dealers' stocks of brick, cement and hollow tile about exhausted.

Birmingham—Lack of cars, for shipping out orders, tending to pile up materials stocks beyond usual limits.

New York—Shipments of sewer pipe from mills, improved within the last week; pine lumber deliveries, however, take five to six weeks as against seven to nine weeks, during October. Cement stocks are low but plenty of other kiln products available. Owing to freight embargoes, materials not transported by water, are holding up building construction to a considerable extent.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 50,000,000 ft.); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta, 10 days); and stocks on hand in general terms, example: (common brick, Philadelphia, no reserve).

	San Francisco	Denver	Minneapolis	New Orleans	Atlanta	Philadelphia	Birmingham	New York
Sewer pipe	Plenty	Del. 24 hr. local plant	.....	Plentiful	Del. 10 days	Depleted in most sizes	Large	Mill del. improving
Cement	Low	Del. held up by car shortage	Warehouses depleted	Fair	15 cars	Stocks small	Plenty	Stocks low
Lime	Enough	Plenty	No shortage	.....	10 cars	Sold faster than shipped in	Extensive	Plenty
Common brick	Well supplied	Supply good	Stocks small	Ample	Plenty	No reserve	Well stocked	100 barge-loads Hudson hard brick
Hollow tile	Fair	Sufficient	Supply limited	Sufficient	Del. 5 @ 6 days	Del. held up by car shortage	Big reserve stock	No shortage; del. by water.
Lumber	Used as fast as rec'd. from mill	Local stocks sufficient; mill shipments delayed.	50,000,000 ft. Dealers' stocks 20 per cent below normal	Stocks 25 per cent normal	Heavy pine stocks	Plenty, some grades	Plenty pine	Pine, del. 5 @ 6 wk. from mill.
Asphalt	Extensive reserves	10 cars	None	No market	10 cars	Heavy reserves	Ample	Large reserves
Structural steel	Stocks low	.....	.....	.....	3 cars	Delayed mill shipments	Heavy	Mill del. affected by car shortage.

REPORT ON COMMON BRICK FROM 81 YARDS AS OF OCT. 1, 1922

Dist. No.	Including States of	No. of Firms Reporting	Plants Closed Down	Burned Brick on Hand	Unburned Brick on Hand	Orders on Books	Price per Thousand At Brickyard
1.	N. Y., New England	5	1	4,053,000	4,785,000	3,326,000	$13.00 to $18.00
2.	Pa., N. J., Md., D. C., Del.	9	1	8,210,000	10,258,000	26,681,000	14.00 to 19.00
3.	Va., N. C., S. C., Ga., Fla.	5	1	820,000	911,000	2,408,000	14.00 to 18.50
4.	Mich., Ohio, W. Va.	11	2	3,707,000	8,490,000	12,409,000	12.50 to 18.00
5.	Ill., Ind., Wis.	25	2	156,674,000	4,677,000	170,524,000	11.00 to 15.50
6.	Ky., Tenn., Miss., Ala., Ark., La.	10	0	5,599,000	5,426,000	12,567,000	9.25 to 16.00
7.	N. & S. Dak., Minn., Neb., Ia., Kan., Mo.	5	3	2,758,000	99,000	520,000	10.50 to 18.00
8.	Okla., Tex., N. M.	5	1	5,545,000	1,030,000	1,108,000	7.50 to 12.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah, Colo.	3	0	259,000	350,000	835,000	13.50 to 16.00
10.	Calif., Ariz., Nev.	3	0	3,131,000	6,136,000	3,950,000	14.50 to 15.50
		81	11	190,756,000	42,162,000	234,328,000	

Fifty Big Contracts Since Sept. 1 Total $82,450,907

Of These, Industrial Plants Lead—Commercial Buildings Next—Hotels and Apartments Third

Lists of contracts awarded on the most important engineering construction projects since the first of the year have been published from time to time in *Engineering News-Record* in the following order: twenty-six covering the first quarter of the current year, in the Searchlight Advertising Section of the April 20 issue; fifty, awarded from March to June, in the July 27 issue, p. 169, and twenty-five lettings between June and August, in the Aug. 31 issue, p. 375.

In this issue the accompanying table shows fifty of the largest awards recently let or actually under way since Sept. 1. These jobs represent a total value of $82,450,907, 34 per cent or $28,450,000 of which was for industrial expansion, indicating the general upward turn in this class of construction.

Commercial buildings, i. e., banks, offices, stores and warehouses, stood second with $19,000,000 or 23 per cent and hotels and apartments followed with $16,250,000 or 19 per cent of the total for these fifty contracts. Five waterworks jobs totaled $4,500,604.

To Insure Long-Time Supply of Building Mechanics

A. G. C. Recommends Plans to Remedy Conditions Revealed by Its Survey of Situation

By Eugene Young
Executive Secretary, the Associated General Contractors of America

It is plain to anyone studying the operation and effect of the three per cent immigration law that, if continued, it will foster a labor monopoly which will seriously effect the whole nation, and that a speedy relief is imperative which will provide for scientific, selective immigration, equal to the country's need. Our domestic industrial regulations are such that our recruiting sources are practically limited to the supply created through apprentices. A survey recently conducted by the Associated General Contractors of America has disclosed some startling conditions in this field. In every case except that of the plumbers, fewer apprentices were employed per thousand journeymen than in 1910, and in the case of bricklayers, plasterers and carpenters, the number of apprentices employed is less than 50 per cent of the number of mechanics dying or retiring on account of old age. The situation, therefore, resolves itself into two problems. The first is to provide, as quickly as possible, mechanics to supply the present shortage. The second is to interest young men in the building trades and to provide means for their education.

To assist in solving the first problem, we recommend: (a) That men now engaged on construction work as building laborers and otherwise who show an aptitude be employed as helpers to the skilled mechanics, being permitted to do any work their experience warrants. In a short time they could execute much of the plain work, releasing the older and more skillful mechanics for the most intricate work. (b) That there be established by employers, under their control, special trade schools where the age limit and scholastic requirements be waived, and the only conditions for entrance be an aptitude for and a willingness to learn a given trade. These schools should teach merely the handling of tools and the rudiments of the trade, leaving skill and efficiency to be acquired on the job, where experience has shown it is most successfully acquired.

The second problem is to provide means to insure a supply of mechanics to care for the normal growth of the nation. To do this all building trade organizations and persons interested in the construction business, should inaugurate a campaign to attract young

ESSENTIAL DATA ON LARGE CONTRACTS AWARDED SINCE SEPTEMBER

Place	Work	Size	Price	Successful Contractors
B. C., Elko	Power house, dam and paper making plant	25,000 hp. plant; concrete dam (Total cost)	$10,000,000	McDougall & McNeill, Ltd., 514 Standard Bank Bldg., Vancouver, B. C.
Calif., Sacramento	Filtration plant		771,957	Mathews Constr. Co., Forum Bldg., Sacramento, Calif.
Colo., Denver	Hotel	8 story with 4 wings	5,000,000	Fleisher Construction Co., 606 Builders Exchange, Minneapolis, Minn.
Conn., Devon (Milford P. O.)	Power plant unit	1 story	2,000,000	J. A. P. Crisfield Construction Co., Gravers Lane, Germantown, Phila.
D. C., Washington	Office	10 story	4,000,000	G. A. Fuller Co., Munsey Bldg., Washington, D. C.
D. C., Washington	Office		1,500,000	J. Stewart, 30 Church St., New York
Ill., Chicago	Hotel	10 story, 160x348 ft. (1st. unit)	5,000,000	Caldwell & Son, State Savings & Trust Bldg., Indianapolis, Ind.
Ill., Chicago	Plant	3 story, 125x240 ft.	500,000	Simpson Construction Co., 133 West Washington St., Chicago, Ill.
Ill., Chicago	Bank	8 story, 65x115 ft.	500,000	F. Burke, 35 S. Dearborn Rd., Chicago, Ill.
Ill., Urbana	Stadium		2,500,000	English Bros., 419 Lincoln Bldg., Champaign, Ill.
Md., Baltimore	Hospital	9 buildings	658,600	Price Constr. Co., Maryland Trust Bldg., Baltimore, Md.
Md., Williamsport	Generating plant	30,000 kw.	2,000,000	Sanderson & Porter, 52 William St., New York, N. Y.
Mass., Boston	Office	12 story, 113x184 ft.	3,000,000	Evatt Construction Co., 161 Devonshire St., Boston, Mass.
Mass., Somerville	High school	3 story	800,000	F. G. Coburn, 294 Washington St., Boston, Mass.
Mass., Weymouth	Power plant	60,000 kw.	8,000,000	Stone & Webster, 120 Broadway, New York
Mich., Detroit	Plant	1 story, 245x1,570 ft.	750,000	Walbridge-Aldinger Co., Penobscot Bldg., Detroit
Mich., Detroit	Sewers		1,246,028	T. A. Gillespie Co., 50 Church St., New York, N. Y.
Mich., Detroit	Office	14 story, 168x177 ft.	2,500,000	O. Misch Co., 1370 Broadway Ave., Detroit, Mich.
Mich., Detroit	Apartment	10 story, 150x171 ft.	1,500,000	Natl. Construction Co., 1031 Dime Bank Bldg., Detroit, Mich.
Mich., Detroit	Hotel	14 story	1,000,000	Van Blarcom Co., Plymouth Bldg., Cleveland, O.
Mich., Flint	Plant	2 story, 202x401 ft.	500,000	Realty Construction Co., Flint, Mich.
Mich., Hantramck	Plant	8 story, 200x400 ft.	1,500,000	Day labor. Smith, Hinchman & Grylls, 800 Marquette Bldg., Detroit, Engrs.
Minn., Duluth	Hotel	12 story, 100x140 ft.	1,500,000	Jacobson Bros., 619 Columbia Bldg., Duluth, Minn.
Minn., Minneapolis	Apartment hotel	13 story, 50x150 ft. with 3 wings	1,500,000	Fleisher Construction Co., 1000 Builders Exchange, Minneapolis, Minn.
Mo., Cape Girardeau	Sewerage system		330,866	J. J. Dunegan, Shenandoah, Ia.
Mont. Billings	Ditch		450,000	O. Schleuter, Fremont Neb. and H. Schleuter, Cartersville
N. Y., Geneva	Plant	160x280 ft.	1,000,000	Curan-Mason, Inc., Rochester, N. Y.
N. Y., Long Island City	Warehouse		1,750,000	Amer. Concrete Steel Co., 27 Clinton St., Newark, N. J.
N. Y., New York	Clubhouse	9 story, 128x168 ft.	750,000	M. Eidlitz & Son, Inc., 41 E. 42d St., New York
N. Y., New York	School		624,000	T. Dwyer, Broadway & 216th St., New York
N. Y., New York	Hotel	12 story, 115x130 ft.	750,000	Empire Contracting Organization, Inc., 130 W. 42d St., New York, N. Y
N. Y., New York	Sewers		518,984	Spadaro Contracting Co., 827 E. 217th St., New York, N. Y.
N. Y., New York	Store and office	12 story, 45x100 ft.	1,250,000	Fountain & Choate, 110 E. 23rd St., New York
Okla, Tulsa	Water supply project			
	Dam		787,610	Standard Paving Co., 321 N. Boston St., Tulsa
	Tunnel and approaches		304,057	Standard Paving Co., 321 N. Boston St., Tulsa
	60 in. concrete conduit		2,136,980	Walbridge-Aldinger Co., Penobscot Bldg., Detroit, Mich.
Pa., Clairton	Plant		2,000,000	Koppers Co., Farmers Bank Bldg., Pittsburgh, Pa.
Pa., Jeanette	Plant	1 story	1,500,000	Heyl & Paterson, Inc., 51 Water St., Pittsburgh, Pa.
Pa., Philadelphia	Office	17 story, 53x230 ft.	1,000,000	F. W. Mark Construction Co., Commercial Trust Bldg., Philadelphia, Pa.
Pa., Philadelphia	Office	20 story, 79x138 ft.	1,250,000	F. W. Mark Construction Co., Commercial Trust Bldg., Philadelphia, Pa.
Pa., Philadelphia	Plant	7 story, 71x104 ft.	700,000	J. N. Gill Construction Co., Otis Bldg., Philadelphia, Pa.
Pa., Pittsburgh	Bank		1,000,000	Mellon-Stuart Co., Oliver Bldg., Pittsburgh, Pa.
Que., Montreal	Water mains	11,000 ft. 40 in., 2,000 ft. 30 in.	500,000	Laurin & Leitch Eng. & Construction Co., 590 Union Ave., Montreal, Que.
Que., Montreal	Quay walls	4,500 ft. long	450,000	Atlas Construction Co., Belmont St., Montreal, Que.
Que., Montreal	Piers		409,950	Atlas Construction Co., Belmont St., Montreal, Que.
R. I., Scituate	Tunnel		1,318,340	Keystone State Construction Co., 210 S. 13th St., Philadelphia, Pa.
Tex., Ft. Worth	Sewage disposal plant, Imhoff tanks, filters, etc.		525,090	McKinsie Construction Co., 302 West Mulberry St., San Antonio, Tex
Utah, Salt Lake City	Bank and office	20 story	1,250,000	P. J. Walker & Co., Monadnock Bldg., San Francisco, Calif.
Va., Winchester	School	1 story, 197x551 ft.	1,000,000	J. L. Crouse, Greensboro, N. C.
Wis., Madison	Hospital	7 story, 250x300 ft.	668,443	Immel Construction Co., 200 N. Main St., Fond du Lac, Wis.
Total			$82,450,907	

men to the trades; showing how interesting, profitable and honorable mechanical vocations are. Educational officers, both state and municipal, should be urged to establish courses to teach the building trades. having in charge men who have had actual experience at the trade in addition to theoretical knowledge.

Trade unions should be induced to revise their rules regulating apprentices. Under the present rules it is impossible to interest either the American youth or the employer. Under these rules. apprentices are limited to boys between the ages of 16 and 20 years. It is well known that few American boys have any serious intention to learn a trade. Only after they have reached their majority do they look on life seriously and realize the necessity of having some trade.

The length of time required for apprentices is from 2 to 4 years. This is too long to teach the rudiments of a trade and is longer than a young man is willing to work for the wages an employer can afford to pay for the kind of work apprentices are permitted to do. Because of this limitation on the scope of employment, the boys' wages are small. His whole outlook is limited,—quite naturally, he is discouraged—and he quits the job. General utility work would expand his knowledge and experience, make him a more all-around useful mechanic to both the employer and himself.

As apprenticeship rules are made by the local unions, it is up to the local employer to work the desired changes. The situation really is serious.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 2; the next, on December 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$3.14	$3.95	$4.20	+$3.02½	$3.15	$3.85	$3.25	$3.80	$3.75
Structural rivets, 100 lb	3.85	4.60	6.00	+3.75	4.00	4.80	4.50	5.00	—5.50
Reinforcing bars, ¾ in. up, 100 lb	3.04	3.85	4.00	+2.92½	3.05	3.85	3.00	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	61.15%	45%	59½%	+57-5%	41%	47.9%	+40%	30.00
Cast-iron pipe, 6 in. and over, ton	55.30	—50.00	51.50	48.70	55.50	63.00	+54.00	—53.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd	+2.00	2.00	2.25	+2.25	1.75	+1.90	2.25	1.00	1.50
Sand, cu.yd	1.00	1.35	1.87½	+2.25	1.00	+1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd	1.75	+2.10	1.65	+2.25	2.25	3.50	2.25	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	59.00	42.00	40.00	51.00	—39.75	39.75	35.00	—22.00	50.00
Lime, finishing, hydrated, ton	+16.80@17.17	23.00	—22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl	2.75@3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	17.45@18.28	12.00	—9.90	11.00	18@19	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0776	.115	.1101	—.0796	.065	....	.11	.08
Hollow partition tile 4x12x12, per block	.1230	.0776	.115	.0808	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal	.93	.97	—1.07	+.95	1.00	1.08	1.04	.86	—1.02
Common Labor:									
Common labor, union, hour	.60	.35	.....	.....	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	+.45@.60	.30	+.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	—.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par.) Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

In the face of freight embargoes upon shipments of badly needed building materials, consequent to the most acute car shortage in railway history, premiums, recently ruling, on prompt deliveries of structural steel, are rapidly disappearing from the market. The exigency, however, recently prompted a firm of New York contractors to purchase twenty-five bad order freight cars and make repairs at their own expense, in order to expedite necessary steel shipments.

Shapes are quoted as low as $1.90 on attractive tonnages and at a maximum of $2.10 where orders involve special considerations and speed in shipment, consistent with present embargoes, but average remains at $2 per 100 lb., f.o.b. Pittsburgh. Market is soft on reinforcing bars with few new inquiries. Some orders booked at $1.90 but average price $2. Sales, however, of carload lots for early delivery, quoted at $2.10 per 100 pounds.

Cast-iron pipe advanced $3 in San Francisco but telegraphic reports from Seattle show a drop of $1 per ton, owing to the fact that shipments are coming through much easier this week.

Transportation difficulties have adversely affected sand, gravel and crushed stone. Advances are reported in Chicago, Denver, Atlanta, and New York.

Yellow pine prices fairly firm throughout the country; Douglas fir dropped $1.25 in Minneapolis and $2.50 per M. ft. in Seattle during the week.

Downward tendency of cement prices reflected in quotations of $2.48 as against $2.73 per bbl., without bags, f.o.b. Jersey City; $2.47, down from $2.48 at Toledo and Detroit, respectively.

Linseed oil though firm in New York for several weeks, has dropped 6c. in Dallas and 4c. per gal. in Montreal.